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IVERSITY PUBLICATIONS NEW SERIES, No. 148

Harvard University

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THE
LAWRENCE SCIENTIFIC SCHOOL

1904–05

CAMBRIDGE, MASS.
Published by Harvard University
September 8, 1904

THE UNIVERSITY PUBLICATIONS

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six times a month from April to July inclusive.

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The Annual Reports of the President and of the Treasurer.

The Annual University Catalogue.

The Annual Catalogues of the College and the several Professional Schools of the University; the Announcements of the several Departments; etc., etc.

THE

LAWRENCE SCIENTIFIC SCHOOL

OF

HARVARD UNIVERSITY

CATALOGUE OF OFFICERS AND STUDENTS
ANNOUNCEMENTS

CAMBRIDGE
Published by the University
1904

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1904/05

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SCIENTIFIC SCHOOL CALENDAR.

1904.

Sept. 19–24, Monday to Saturday.	Examinations for admission to Harvard College, the Lawrence Scientific School, and the Dental School.
Sept. 28, Wednesday.	Registration of students.
Sept. 29, Thursday.	**Academic Year** begins. Registration of students continued.
Nov. 24, Thursday.	Thanksgiving Day: a holiday.

Recess from December 23, 1904, to January 2, 1905, inclusive.

1905.

Feb. 13, Monday.	**Second half-year** begins.
Feb. 22, Wednesday.	Washington's Birthday: a holiday.
Apr. 1, Saturday.	Last day for receiving dissertations for the Bowdoin Prizes.

Recess from April 16 to April 22, inclusive.

May 30, Tuesday.	Memorial Day: a holiday.
June 28, Wednesday.	**Commencement.**

Summer Vacation of Thirteen Weeks, from Commencement Day to September 27, inclusive.

DEPARTMENTS OF THE UNIVERSITY.

The University comprehends the following departments : —

Harvard College,
The Lawrence Scientific School,
The Graduate School,
The Divinity School,
The Law School,
The Medical School,
The Dental School,
The Bussey Institution (a School of Agriculture),
The Arnold Arboretum,
The University Library,
The Museum of Comparative Zoölogy,
The Peabody Museum of American Archaeology and Ethnology,
The University Museum,
The Botanic Garden,
The Gray Herbarium,
The Astronomical Observatory.

☞ Students in regular standing in any one department of the University are admitted free to the instruction and the examinations given in any other department, with the exception of exercises carried on in the special laboratories. But no student whose tuition fee for the year amounts to less than $150 is admitted to exercises given in any department other than that in which he is enrolled, except by special permission of the Dean of the department in which the instruction is given, after being duly accredited thereto by the Dean of the department of which the student is a member.

ADMINISTRATIVE OFFICERS.

President: CHARLES WILLIAM ELIOT, A.M., LL.D.
Office, 5 University Hall, Cambridge.

Treasurer: CHARLES FRANCIS ADAMS, 2d, A.B., LL.B.
Office, 50 State St., Boston.

Dean of the Lawrence Scientific School and Chairman of the Committee on the Summer School: NATHANIEL SOUTHGATE SHALER, S.D., LL.D.
Office, 16 University Hall. Office hours, daily, 9 A.M., except Saturday.

Secretary of the Lawrence Scientific School and Clerk of the Summer School: JAMES LEE LOVE, A.M.
Office, 16 University Hall. Office hours, 9 to 10 A.M. and 3 P.M.; Saturday, 9 to 10 A.M.

Dean of the Faculty of Arts and Sciences: LE BARON RUSSELL BRIGGS, A.M., LL.D.
Office, 5 University Hall. Office hours, 9 A.M., Mon., Wed., and Fri.

Secretary of the Faculty of Arts and Sciences: JOHN GODDARD HART, A.M.
Office, 5 University Hall. Office hours, daily 9 A.M. to 12 M.

Recorder of the Faculty of Arts and Sciences: GEORGE WASHINGTON CRAM, A.B.
Office, 4 University Hall. Office hours, 9 A.M. to 1 P.M.

Chairman of the Parietal Board: CHARLES MINER STEARNS, A.B.
Office, 5 University Hall. Office hours, daily, except Saturday, 9 A.M.

Librarian: WILLIAM COOLIDGE LANE, A.B.
Office, Gore Hall, Cambridge.

Director of the Hemenway Gymnasium: DUDLEY ALLEN SARGENT, M.D., S.D.
Office, Hemenway Gymnasium.

Bursar: CHARLES FRANK MASON, A.B.
Office, Dane Hall, Cambridge. Office hours, 9 A.M. to 1 P.M.

Publication Agent: JOHN BERTRAM WILLIAMS, A.B.
Office, 2 University Hall, Cambridge. Office hours, 9 A.M. to 5 P.M.; Saturday, 9 A.M. to 12.30 P.M.

THE PRESIDENT AND FELLOWS OF HARVARD COLLEGE.

This Board is commonly known as the CORPORATION.

PRESIDENT.

CHARLES WILLIAM ELIOT, A.M., LL.D.,
17 Quincy St., Cambridge.

FELLOWS.

HENRY PICKERING WALCOTT, A.B., M.D.,
11 Waterhouse St., Cambridge.

HENRY LEE HIGGINSON, A.M., LL.D., 44 State St., Boston.

FRANCIS CABOT LOWELL, A.B.,
107 Post Office Building, Boston.

ARTHUR TRACY CABOT, A.M., M.D.,
3 Marlborough St., Boston.

TREASURER.

CHARLES FRANCIS ADAMS, 2d, A.B., LL.B.,
50 State St., Boston.

THE BOARD OF OVERSEERS.

The President and Treasurer of the University, *ex officio*, and the following persons by election: —

1905.*

WILLIAM AMOS BANCROFT, A.B., 12 Ware St., Cambridge.

CHARLES ELIOT NORTON, Litt.D., LL.D., D.C.L., Shady Hill, off Irving St., Cambridge.

WILLIAM EVERETT, Ph.D., L.H.D., LL.D., Quincy.

STEPHEN MINOT WELD, A.M., 89 State St., Boston.

WILLIAM CALEB LORING, LL.B., LL.D., Court House, Boston.

1906.

SAMUEL HILL, A.B., Seattle, Wash.

GEORGE FRISBIE HOAR, LL.B., LL.D., Worcester.

WILLIAM LAWRENCE, A.B., D.D., 101 Brattle St., Cambridge.

HERBERT PUTNAM, A.B., Litt.D., LL.D., Washington, D.C.

GEORGE BRUNE SHATTUCK, A.M., M.D., 183 Beacon St., Boston.

1907.

CHARLES FRANCIS ADAMS, A.B., LL.D., 23 Court St., Boston.

AUGUSTUS HEMENWAY, A.B., 10 Tremont St., Boston.

ROBERT GRANT, Ph.D., LL.B., 211 Bay State Road, Boston.

CHARLES STEBBINS FAIRCHILD, LL.B., LL.D., 10 West 8th St., New York, N.Y.

MOSES WILLIAMS, A.B., Cunard Building, Boston.

* The term expires, in each case, on Commencement Day of the year indicated.

1908.

JOHN DAVIS LONG, A.B., LL.D., *President,* Hingham.

EDMUND WETMORE, A.B., LL.B., 34 Pine St., New York, N.Y.

EDWIN PLINY SEAVER, A.M., LL.B., Waban.

ROBERT BACON, A.B., 23 Wall St., New York, N.Y.

DAVID WILLIAMS CHEEVER, M.D., LL.D., 557 Boylston St., Boston.

1909.

FRANCIS LEE HIGGINSON, A.B., 50 State St., Boston.

JAMES JACKSON STORROW, A.B., LL.B., 44 State St., Boston.

GEORGE ANGIER GORDON, A.B., D.D., 645 Boylston St., Boston.

FRANCIS RANDALL APPLETON, A.B., LL.B., 21 Maiden Lane, New York, N.Y.

WILLIAM WATSON GOODWIN, Ph.D., LL.D., D.C.L., 5 Follen St., Cambridge.

1910.

MOORFIELD STOREY, A.M., 735 Exchange Building, Boston.

HENRY SHIPPEN HUIDEKOPER, A.M., 1704 Pine St., Philadelphia, Pa.

JOHN NOBLE, LL.B., LL.D., Court House, Pemberton Sq., Boston.

WINSLOW WARREN, A.B., LL.B., 262 Washington St., Boston.

PAUL REVERE FROTHINGHAM, A.M., S.T.B., 294 Beacon St., Boston.

SECRETARY OF THE BOARD OF OVERSEERS.

WINTHROP HOWLAND WADE, A.M., LL.B., 53 State St., Boston.

THE FACULTY OF ARTS AND SCIENCES.

FACULTY OF ARTS AND SCIENCES.

Charles William Eliot, A.M., LL.D., President.

Le Baron Russell Briggs, A.M., LL.D., Dean, and *Professor of English.*

James Mills Peirce, A.M., *Professor of Astronomy and Mathematics.*

Crawford Howell Toy, A.M., LL.D., *Professor of Hebrew.*

John Knowles Paine, A.M., Mus.D., *Professor of Music.*

George Lincoln Goodale, M.D., LL.D., *Professor of Natural History*, and *Director of the Botanic Garden.*

Charles Herbert Moore, A.M., *Professor of Art*, and *Director of the Fogg Art Museum.*

Frederic Ward Putnam, A.M., S.D., *Professor of American Archaeology and Ethnology*, and *Curator of the Peabody Museum.*

Nathaniel Southgate Shaler, S.D., LL.D., *Professor of Geology*, and *Dean of the Lawrence Scientific School.*

Clement Lawrence Smith, A.M., LL.D., *Professor of Latin.*

George Herbert Palmer, A.M., Litt.D., LL.D., *Professor of Philosophy.*

John Trowbridge, S.D., *Professor of Physics*, and *Director of the Jefferson Physical Laboratory.*

William Gilson Farlow, M.D., LL.D., *Professor of Cryptogamic Botany.*

William James, M.D., Ph. et Litt.D., LL.D., *Professor of Philosophy.*

Charles Loring Jackson, A.M., *Professor of Chemistry.*

Frederick Caesar de Sumichrast, *Associate Professor of French.*

John Williams White, Ph.D., LL.D., Litt.D., *Professor of Greek.*

William Morris Davis, M.E., *Professor of Geology.*

Francis Greenwood Peabody, A.M., D.D., *Professor of Christian Morals*, and *Dean of the Faculty of Divinity.*

Minton Warren, Ph.D., LL.D., *Professor of Latin.*

William Elwood Byerly, Ph.D., *Professor of Mathematics.*

Ephraim Emerton, Ph.D., *Professor of Ecclesiastical History.*

Charles Rockwell Lanman, Ph.D., LL.D., *Professor of Sanskrit*, and *Editor of the Harvard Oriental Series.*

Edward Laurens Mark, Ph.D., LL.D., *Professor of Anatomy*, and *Director of the Zoölogical Laboratory.*
George Foot Moore, A.M., D.D., LL.D., *Professor of Theology.*
Edward Stevens Sheldon, A.B., *Professor of Romance Philology.*
Silas Marcus Macvane, Ph.D., *Professor of History.*
Horatio Stevens White, A.B., LL.D., *Professor of German.*
Robert Wheeler Willson, Ph.D., *Professor of Astronomy.*
John Henry Wright, A.M., LL.D., *Professor of Greek*, and *Dean of the Graduate School.*
Edward Dyer Peters, M.D., *Professor of Metallurgy.*
Kuno Francke, Ph.D., *Professor of German Literature*, and *Curator of the Germanic Museum.*
Edwin Herbert Hall, Ph.D., *Professor of Physics.*
David Gordon Lyon, Ph.D., D.D., *Professor of Divinity*, and *Curator of the Semitic Museum.*
Denman Waldo Ross, Ph.D., *Lecturer on the Theory of Design.*
Josiah Royce, Ph.D., LL.D., *Professor of the History of Philosophy.*
Philippe Belknap Marcou, Ph.D., *Assistant Professor of Romance Languages.*
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Benjamin Osgood Peirce, Ph.D., *Professor of Mathematics and Natural Philosophy.*
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Hans Carl Günther von Jagemann, Ph.D., *Professor of Germanic Philology.*
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Frank William Taussig, Ph.D., LL.B., *Professor of Economics.*
Leo Wiener, *Assistant Professor of Slavic Languages and Literatures.*
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Jeffrey Richardson Brackett, Ph.D., *Instructor in Charity, Public Aid and Correction.*

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Walter Raymond Spalding, A.M., *Assistant Professor of Music.*

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Maxime Bôcher, Ph.D., *Professor of Mathematics.*

Walter Safford Burke, *Inspector of Grounds and Buildings.*

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Charles Jesse Bullock, Ph.D., *Assistant Professor of Economics.*

Gustavus Howard Maynadier, Ph.D., *Instructor in English.*

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Eugene Abraham Darling, A.M., M.D., *Instructor in Hygiene.*

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Comfort Avery Adams, S.B., *Assistant Professor of Electrical Engineering.*

Charles Leonard Bouton, Ph.D., *Assistant Professor of Mathematics.*

Thomas Nixon Carver, Ph.D., *Professor of Political Economy.*

William Fenwick Harris, A.M., *Assistant Professor of Greek.*

William Guild Howard, A.M., *Instructor in German.*

Charles Palache, Ph.D., *Assistant Professor of Mineralogy.*

Fred Norris Robinson, Ph.D., *Assistant Professor of English.*

Jay Backus Woodworth, S.B., *Assistant Professor of Geology.*

Charles Henry Conrad Wright, A.M., *Assistant Professor of French.*

Frank Lowell Kennedy, A.B., S.B., *Assistant Professor of Drawing and Machine Design.*

Lionel Simeon Marks, S.B., M.M.E., *Assistant Professor of Mechanical Engineering.*

William Ernest Castle, Ph.D., *Assistant Professor of Zoölogy.*

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George Washington Pierce, Ph.D., *Instructor in Physics.*

Henry Augustus Torrey, Ph.D., *Instructor in Chemistry.*

Abram Piatt Andrew, Jr., Ph.D., *Assistant Professor of Economics.*

Jeremiah Denis Matthias Ford, Ph.D., *Assistant Professor of Romance Languages.*

Hector James Hughes, A.B., S.B., *Assistant Professor of Hydraulics and Sanitary Engineering.*

Frederick Law Olmsted, A.B., *Professor of Landscape Architecture.*

Edward Kennard Rand, Ph.D., *Instructor in Latin.*

Oliver Mitchell Wentworth Sprague, Ph.D., *Assistant Professor of Economics.*

Charles Henry White, S.B., A.M., *Instructor in Mining and Metallurgy.*

Julian Lowell Coolidge, A.B., B.Sc., *Instructor in Mathematics.*

Edward Vermilye Huntington, Ph.D., *Instructor in Mathematics.*

William Bennett Munro, Ph.D., LL.B., *Instructor in Government.*

Murray Anthony Potter, Ph.D., *Instructor in Romance Languages.*

James Kelsey Whittemore, A.M., *Instructor in Mathematics.*

Gregory Paul Baxter, Ph.D., *Instructor in Chemistry.*

George Henry Chase, Ph.D., *Instructor in Classical Archaeology.*

Edward Bissell Holt, Ph.D., *Instructor in Psychology.*

Gilbert Newton Lewis, Ph.D., *Instructor in Chemistry.*

Arthur Asahel Shurtleff, S.B., *Instructor in Landscape Architecture.*

Bruce Wyman, A.M., LL.B., *Assistant Professor of Law.*

Roland Burrage Dixon, Ph.D., *Instructor in Anthropology.*

Merritt Lyndon Fernald, S.B., *Instructor in Botany*, and *Assistant at the Gray Herbarium.*

Theodore Lyman, Ph.D., *Instructor in Physics.*

Harry Wheeler Morse, Ph.D., *Instructor in Physics.*

Arthur Orlo Norton, A.M., *Instructor in the History and Art of Teaching.*

Richard Thornton Fisher, A.B., M.F., *Instructor in Forestry.*

APPOINTED FOR THE YEAR 1904–05.

PREACHERS TO THE UNIVERSITY.*

Lyman Abbott, D.D., LL.D.,	New York, N. Y.
Floyd Williams Tomkins, A.B., D.D.,	Philadelphia, Pa.
Henry Van Dyke, D.D., LL.D.,	Princeton, N. J.
John Heyl Vincent, A.B., LL.D.	
William Wallace Fenn, A.M., S.T.B.,	Cambridge.

MEDICAL VISITOR.

Marshall Henry Bailey, M.D.,	47 Brattle St.

INSTRUCTORS.†

George I. Aldrich, A.B., *Lecturer on School Administration.*
John George Jack, *in Forestry.*
Harold Broadfield Warren, *in Freehand Drawing.*
Edward Edgecombe Carter, A.B., M.F., *in Forestry.*
Jesse More Greenman, Ph.D., *in Botany.*
Arthur Bowes Frizell, A.M., *in Mathematics.*
Thomas Hall, Jr., A.B., *in English.*
William Curtis Farabee, Ph.D., *in Anthropology.*
Macy Millmore Skinner, Ph.D., *in German.*
Walter Dana Swan, *in Architecture.*
James Sturgis Pray, A.B., *in Landscape Architecture.*
Ralph Barton Perry, Ph.D., *in Philosophy.*
Stephen Edgar Whiting, S.B., *in Electrical Engineering.*
Edgar Huidekoper Wells, A.B., *in English.*
Oakes Ames, A.M., *in Botany.*
Charles Hamilton Ayres, Ph.D., *in Physics.*
Andrew Garbutt, *in Modelling.*
Sylvanus Griswold Morley, Ph.D., *in Romance Languages and Literatures.*
Albert Morey Sturtevant, A.M., *in German.*
Gustavus Adolphus Anderegg, S.B., A.B., *in Electrical Engineering.*
William Arnold Colwell, A.M., *in German.*
Fritz Hagens, A.M., *in German.*
William Luther Mowll, S.B., *in Architecture.*

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* The address of each of the Preachers, during the term of his residence at the University, is No. 1 Wadsworth House.

† This list includes those only who give instruction in courses prescribed for students of the Scientific School.

James Ambrose Moyer, S.B., *in Descriptive Geometry.*
Hans Hugo Pringsheim, Ph.D., *in Chemistry.*
Philip Sidney Smith, A.M., *in Geology.*
Henry Cook Boynton, A.B., S.M., *in Metallurgy and Metallography.*
John Felt Cole, A.B., *in Astronomy.*
Arthur Edwin Norton, Ph.B., *in Mechanical Drawing and Mathematics.*
Roger Clark Wells, A.B., *in Chemistry.*
Francis Wolson Snow, *in Romance Languages.*

AUSTIN TEACHING FELLOWS.

George Rogers Mansfield, S.B., A.M., *in Geology.*
James Mackintosh Bell, A.M., *in Mining and Metallurgy.*
Arthur Day Howard, S.M., *in Zoölogy.*
Leon Jacob Cole, A.B., *in Zoölogy.*
Arthur Houston Chivers, A.B., *in Botany.*
George Shannon Forbes, A.B., *in Chemistry.*
Frederick William Russe, A.M., *in Chemistry.*
James Alfred Field, A.B., *in Economics.*
Joseph Abraham Long, S.B., *in Botany.*
Louis Ross, A.B., *in Applied Mechanics.*
Arthur Tyng, A.B., *in Engineering.*

ASSISTANTS.

Francis Samuel Philbrick, Ph.D., *in Government.*
Hiram Bingham, A.M., *in History.*
Charles Edmund Fryer, A.M., *in History.*
James Augustus George, A.M., *in Government.*
Frederic Austin Ogg, A.M., *in History.*
Amon Benton Plowman, A.M., *in Botany.*
Lyman Kenneth Clark, A.M., *in Government.*
Vanderveer Custis, A.M., *in Economics.*
Chester Whitney Wright, A.M., *in Economics.*
John Frank Langmaid, A.M., *in Chemistry.*
Schuyler B Serviss, A.M., *in Physics.*
Herbert Melville Boylston, S.B., *in Metallurgical Chemistry.*
Roger Castle Griffin, A.B., *in Chemistry.*
Frederick Arthur Alden, *in Mechanical Drawing.*
Harry Louis Frevert, *in Chemistry.*
Edward Russell Markham, *in Shopwork.*
Robert Newton Woodworth, *in Ore Dressing and Assaying.*

DIVISIONS AND DEPARTMENTS.

I. SEMITIC LANGUAGES AND HISTORY. Professor Lyon, chairman.

II. ANCIENT LANGUAGES. Professor H. W. Smyth, chairman.
  A. *Indic Philology.* Professor Lanman, chairman.
  B. *The Classics (Greek, Latin).* Professor Morgan, chairman.

III. MODERN LANGUAGES. Professor Kittredge, chairman.
  A. *English.* Professor Briggs, chairman.
  B. *Germanic Languages and Literatures.* Professor von Jagemann, chairman.
  C. *French, and other Romance Languages and Literatures.* Professor Grandgent, chairman.

IV. HISTORY AND POLITICAL SCIENCE. Professor Carver, chairman.
  A. *History and Government.* Professor Gross, chairman.
  B. *Political Economy.* Professor Ripley, chairman.

V. PHILOSOPHY. Professor Münsterberg, chairman.

VI. THE FINE ARTS. Professor Charles H. Moore, chairman.
  A. *History and Principles of the Fine Arts.* Professor Charles H. Moore, chairman.
  B. *Architecture.* Professor H. L. Warren, chairman.

VII. MUSIC. Professor Paine, chairman.

VIII. MATHEMATICS. Professor J. M. Peirce, chairman.

IX. ENGINEERING. Professor Hollis, chairman.

X. PHYSICS. Asst. Professor Sabine, chairman

XI. CHEMISTRY. Professor Richards, chairman.

XII. BIOLOGY. Professor Mark, chairman.
  A. *Botany.* Professor Thaxter, chairman.
  B. *Zoölogy.* Asst. Professor G. H. Parker, chairman.

XIII. GEOLOGY. Professor Wolff, chairman.
  A. *Geology and Geography.* Asst. Professor Ward, chairman.
  B. *Mineralogy and Petrography.* Asst. Professor Palache, chairman.
  C. *Mining and Metallurgy.* Professor H. L. Smyth, chairman.

XIV. ANTHROPOLOGY. Professor Putnam, chairman.

LAWRENCE SCIENTIFIC SCHOOL.

ADMINISTRATIVE BOARD.

Nathaniel Southgate Shaler, S.D., LL.D., Dean, and *Professor of Geology.*

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Herbert Langford Warren, A.M., *Professor of Architecture.*

Charles Robert Sanger, Ph.D., *Professor of Chemistry.*

Arthur Edwin Kennelly, Sc.D., *Professor of Electrical Engineering.*

Henry Lloyd Smyth, A.B., C.E., *Professor of Mining and Metallurgy.*

James Lee Love, A.M., Secretary, and *Assistant Professor of Mathematics.*

Edward Charles Jeffrey, Ph.D., *Assistant Professor of Vegetable Histology.*

Eugene Abraham Darling, A.M., M.D., *Instructor in Hygiene.*

Frank Lowell Kennedy, A.B., S.B., *Assistant Professor of Drawing and Machine Design.*

William Ernest Castle, Ph.D., *Assistant Professor of Zoölogy.*

John Goddard Hart, A.M., *Instructor in English*, and *Secretary of the Faculty of Arts and Sciences.*

Charles Henry White, S.B., A.M., *Instructor in Mining and Metallurgy.*

Arthur Orlo Norton, A.M., *Instructor in the History and Art of Teaching.*

George Washington Pierce, Ph.D., *Instructor in Physics.*

COMMITTEE OF ADVISERS.

Professor N. S. Shaler, *Chairman*,

Professor R. W. Willson,
" P. H. Hanus,
" H. L. Warren,
" C. R. Sanger,
" H. L. Smyth,
Asst. Professor L. J. Johnson,
Asst. Professor G. H. Parker,
" " L. S. Marks,
Professor F. L. Olmsted,
Asst. Professor F. L. Kennedy,
Mr. S. E. Whiting,
Dr. N. S. Bacon.

COMMITTEE ON ADMISSION FROM OTHER SCIENTIFIC SCHOOLS AND COLLEGES.

Professor N. S. Shaler, *Chairman*,

Professor H. L. Warren,
Asst. Professor J. L. Love,
Asst. Professor W. E. Castle,
Dr. G. P. Baxter.

COMMITTEE ON FOUR-YEAR PROGRAMMES.

Professor N. S. Shaler, *Chairman*,

Professor E. L. Mark,
" I. N. Hollis,
" H. L. Warren,
Professor T. W. Richards,
Asst. Professor W. C. Sabine,
Professor F. L. Olmsted.

STUDENTS, 1903–04.

Adams, Arthur Kinney,	4	Gen. Sci.	*Spencer.*
Adams, Matthew Prior,	4	Sci. T.	*Boston.*
Alexander, William Wesley,	*S.*	Chem.	*Everett.*
Amory, John Austin,	*S.*	Chem.	*Readville.*
Andrews, Harry Wood,	3	Civ. Engin.	*Cambridge.*
Andrus, Leonard Alexander,	2	Civ. Engin.	*Dixon, Ill.*
Arensberg, Francis Louis,	4	Gen. Sci.	*Oakmont, Pa.*
Azarian, Joseph,	1	Gen. Sci.	*Cambridge.*
Baldwin, James Rumford,	3	Civ. Engin.	*Woburn.*
Bangs, Eli Gaynor,	1	Gen. Sci.	*New York, N. Y.*
Barklage, Walter Frederick,	2	Elec. Engin.	*St. Louis, Mo.*
Barnes, Donald Carter, A.B. 1902,	4	Elec. Engin.	*Cambridge.*
Barrett, Robert Edward,	*S.*	Civ. Engin.	*Framingham.*
Barrows, William Morton, B.S. (*Michigan Agric. Coll.*) 1903,	2	Biology.	*Agric. Coll., Mich.*
Bartsch, Rudolf Carl Björn,	2	Chem.	*W. Roxbury.*
Batchelder, William Osgood,	3	Elec. Engin.	*Salem.*
Batten, Rollin Morgan,	4	Hyg.	*Montclair, N.J.*
Bauer, Charles Humphrey,	2	Hyg.	*Jamaica Plain.*
Bauer, Frank Robert,	4	Gen. Sci.	*Bradford, Pa.*
Becker, Sidney Kent,	2	Mech. Engin.	*Buffalo, N. Y.*
Beebe, Manly Colton,	1	Arch.	*Pleasantville, Pa.*
Belden, Josiah Humphrey,	1	Mining.	*Cincinnati, O.*
Bell, James Samuel, Jr.	1	Gen. Sci.	*Cambridge.*
Bergson, Samuel,	2	Mining.	*Dorchester.*
Bickley, Lloyd Wharton,	4	Gen. Sci.	*Arlington.*
Bittenbender, Samuel Theodore,	*S.*	Elec. Engin.	*Brookline.*
Blake, Benjamin Sewall, A.B. 1901,	*S.*	Forestry.	*Auburndale.*
Bleakie, Robert Maxwell,	4	Gen. Sci.	*Brookline.*
Blodgett, John Henry,	4	Gen. Sci.	*Brookline.*
Blossom, Carl Woodruff,	4	Gen. Sci.	*E. Cleveland, O.*
Boggs, Francis Goodnow,	1	Hyg.	*Cambridge.*
Boughton, Willis Arnold,	*S.*	Chem.	*Brooklyn, N. Y.*
Boynton, George William,	*S.*	Mining.	*Davenport, Ia.*
Brackett, Raymond Osgood,	*S.*	Mech. Engin.	*Brookline.*
Bramhall, William Cabot,	*S.*	Gen. Sci.	*Brookline.*
Breed, Archer Fuller, .	2	Elec. Engin.	*Lynn.*
Brill, Karl Friedrich,	*S.*	Mining.	*Hazleton, Pa.*
Brinton, Willard Cope,	*S.*	Mech. Engin.	*W. Chester, Pa.*

Brock, Sidney Frederick Tyler,	2	Mining.	*Philadelphia, Pa.*
Brown, Francis,	3	Elec. Engin.	*Salem.*
Brown, Floyd Andrews,	*S.*	Chem.	*Deposit, N. Y.*
Brown, Harold Irving,	2	Biology.	*Waverley.*
Brown, William Horton,	*S.*	Mech. Engin.	*Marblehead.*
Browne, Parker Richardson,	2	Mining.	*Malden.*
Bruce, Cyrus William,	2	Arch.	*Allston.*
Bryant, Russell Willett,	3	Elec. Engin.	*Buffalo, N. Y.*
Bucke, John Heath,	2	Elec. Engin.	*Cambridge.*
Buffum, Fred Stephen,	2	Gen. Sci.	*Apalachicola, Fla.*
Bullard, Lawrence, A.B. 1901,	3	Land. Arch.	*Roxbury.*
Bullen, Roy,	3	Civ. Engin.	*Richmond, Utah.*
Bunting, Ralph Valentine,	3	Mech. Engin.	*Brookline.*
Burnham, Edwin Francis,	*S.*	Mech. Engin.	*Waltham.*
Burns, Arthur Henry,	2	Mining.	*Worcester.*
Burns, Thomas Richard,	2	Mining.	*Cambridge.*
Burrill, Alfred Cummings,	3	Biology.	*No. Brookfield.*
Cabot, Walter Kinsman,	1	Elec. Engin.	*Cambridge.*
Callahan, John Francis, Jr.	*S.*	Civ. Engin.	*Charlestown.*
Campbell, Robert,	*S.*	Geology.	*Newark, N.J.*
Campbell, Robert Graeme,	*S.*	Mech. Engin.	*New York Mills, N. Y.*
Capers, Francis LeGrand, Jr.	1	Mining.	*Pueblo, Colo.*
Carrick, Frederick Arthur,	2	Gen. Sci.	*Cambridge.*
Carroll, Michael Davitt,	4	Gen. Sci.	*E. Bridgewater.*
Carter, Leslie Dudley,	2	Mech. Engin.	*New York, N. Y.*
Chace, Charles Edward,	*S.*	Civ. Engin.	*Fall River.*
Chace, Carll Smith,	3	Civ. Engin.	*Dorchester.*
Chadbourne, Frank Merriam,	*S.*	Civ. Engin.	*San Francisco, Cal.*
Chapin, Henry Kent,	2	Mining.	*Chicago, Ill.*
Child, Stephen, S.B. (*Mass. Inst. Tech.*) 1888,	*S.*	Land. Arch.	*Auburndale.*
Clapp, Richard Elbridge,	2	Mining.	*Dedham.*
Clapp, William Frederick,	*S.*	Civ. Engin.	*Cambridge.*
Clark, Davis Wasgatt, Jr.	*S.*	Arch.	*Cincinnati, O.*
Clark, Edward Lord, 3d,	1	Civ. Engin.	*Buffalo, N. Y.*
Clark, Thomas Roy,	4	Gen. Sci.	*Bradford, Pa.*
Clark, William Armstrong,	2	Forestry.	*Cincinnati, O.*
Clarkson, Walter,	4	Gen. Sci.	*Cambridge.*
Cloud, Frederick Wills,	3	Elec. Engin.	*Chicago, Ill.*
Coburn, Horace Butterfield, Jr.	2	Civil Engin.	*Lowell.*
Coffin, Lee Kemp,	*S.*	Elec. Engin.	*Melrose.*
Coffin, Leslie Roland,	2	Elec. Engin.	*Long Beach, Cal.*
Coleman, Francis Hamilton,	4	Gen. Sci.	*Dorchester.*

Collings, George Boswell Morey,	4	Gen. Sci.	*Cleveland, O.*
Collner, William Harrison,	1	Gen. Sci.	*St. Petersburg, Pa.*
Conant, Arthur Franklin,	1	Civ. Engin.	*Plainfield, N.J.*
Connolly, Martin Joseph,	*S.*	Mining.	*Jamaica Plain.*
Connolly, Stephen John,	*S.*	Civ. Engin.	*Beverly Farms.*
Copeland, Manton,	4	Biology.	*Taunton.*
Coutant, John Karlton,	2	Elec. Engin.	*Newburgh, N. Y.*
Craig, Charles Robert,	2	Civ. Engin.	*Concord.*
Crane, Roy Elwood,	3	Sci. T.	*Somerville.*
Crane, Richard Teller, 3d,	4	Gen. Sci.	*Chicago, Ill.*
Crawford, Gustavus Chambers, A.B. 1902, A.M. 1903,	4	Elec. Engin.	*St. John, N.B.*
Cross, Eliot Buchanan,	*S.*	Arch.	*New York, N. Y.*
Crosse, Shirley Robbins,	2	Elec. Engin.	*Cambridge.*
Cuesta, Enrique Gallardo,	2	Elec. Engin.	*Guadalajara, Mexico.*
Cummings, Walter Charles,	*S.*	Arch.	*Roxbury.*
Cutler, George David,	*S.*	Hyg.	*Roslindale.*
Cutter, Harold Francis,	3	Gen. Sci.	*Brookline.*
Cutting, Chester Joseph,	3	Mech. Engin.	*Waltham.*
Daggett, Parker Hayward,	*S.*	Civ. Engin.	*Neponset.*
Dane, Charles,	1	Hyg.	*Brookline.*
Dane, John Murphy,	*S.*	Hyg.	*Brookline.*
Danielson, Whitman,	2	Elec. Engin.	*Putnam, Conn.*
Davis, Nelson Clifton,	*S.*	Hyg.	*Providence, R. I.*
Davis, Stewart,	*S.*	Biology.	*Narragansett Pier, R.I.*
Davis, William Morris,	1	Elec. Engin.	*Colorado Springs, Colo.*
Dearborn, Joseph Jewell,	1	Land. Arch.	*Pembroke, N.H.*
DeLong, Harold Clark,	4	Mining.	*New Dorchester.*
Devonshire, Charles Edwin,	1	Mech. Engin.	*Roxbury.*
Dexter, Wilson Chase,	2	Arch.	*Brookline.*
Dignowity, James Victor, Jr.	2	Mining.	*Washington, D.C.*
Dinsmoor, William Bell,	2	Arch.	*Jamaica Plain.*
Ditmars, Harold Edward,	1	Civ. Engin.	*Brooklyn, N. Y.*
Dittman, George Frederick,	2	Gen. Sci.	*Cincinnati, O.*
Dodge, Clyde Raymond,	1	Civ. Engin.	*Haverhill.*
Dorr, Richard Charles,	3	Elec. Engin.	*Worcester.*
Doyen, George Eveline,	1	Civ. Engin.	*Duxbury.*
Doyle, John Francis,	*S.*	Mining.	*Worcester.*
Drury, William Clark,	*S.*	Land. Arch.	*Waltham.*
DuBois, Delafield,	4	Elec. Engin.	*New York, N. Y.*
Dudley, John Charles,	3	Gen. Sci.	*Wilkinsonville.*
Duffy, Charles Louis,	*S.*	Arch.	*Cambridge.*
Duffy, Joseph Michael,	1	Elec. Engin.	*So. Boston.*

Eaton, James Haworth, A.B. (*Univ. of Vermont*), 1903,	2	Civ. Engin.	*Burlington, Vt.*
Eaves, Frederic Beaumont,	1	Gen. Sci.	*Roxbury.*
Eayrs, Thomas Coggeshall,	3	Civ. Engin.	*Cambridge.*
Ebert, Clarence Engelbert,	*S.*	Sci. T.	*Wallingford, Conn.*
Edwards, Dean Gray, A.B. 1903,	4	Civ. Engin.	*Somerville.*
Edwards, Daniel Mann, Jr.	1	Arch.	*Woonsocket, R.I.*
Eldridge, Albert Gould,	1	Sci. T.	*West Lynn.*
Ellis, Francis Blake,	1	Arch.	*Cambridge.*
Ellis, Theodore Hickling,	4	Gen. Sci.	*St. Leonard's-on-the-Sea, Sussex, England.*
Ely, Frederick Burchard,	2	Gen. Sci.	*Hoosick Falls, N. Y.*
Emerson, Joseph Wilson,	2	Mining.	*Whitehall, N. Y.*
Esselen, William Brigham,	2	Gen. Sci.	*Roslindale.*
Estabrook, Winthrop Howe,	1	Civ. Engin.	*Boston.*
Farnham, Harold Sumner,	2	Mech. Engin.	*Cambridge.*
Farrington, Theodore Sweetser,	1	Elec. Engin.	*Lowell.*
Fassett, Francis Henry Gile,	*S.*	Arch.	*Woodfords, Me.*
Fay, Theodore Bradshaw, A.B. 1902,	*S.*	Arch.	*Washington, D.C.*
Feather, Maurice,	1	Arch.	*Waltham.*
Fenno, Stanley Warner,	4	Sci. T.	*Revere.*
Fisher, Charles Heber,	4	Elec. Engin.	*Whitesboro, Del.*
Fitzhugh, Earl Hopkins, Jr.	3	Civ. Engin.	*St. Albans, Vt.*
Fitzpatrick, Frank Richard, A.B. 1903,	2	Mining.	*Arlington.*
Flagg, Charles Monroe,	3	Gen. Sci.	*Cambridge.*
Flint, Philip Witter,	2	Hyg.	*Worcester.*
Foley, Frederick Francis,	*S.*	Elec. Engin.	*Ayer.*
Foley, Martin,	1	Mining.	*Charlestown.*
Forsman, Stanton Watson, S.B. 1901,	4	Mining.	*Williamsport, Pa.*
Forté, Harry Phidias,	1	Mech. Engin.	*Hackettstown, N. J.*
Foster, Channing Mitchell,	*S.*	Biology.	*Boston.*
Fowle, Leonard M,	*S.*	Mech. Engin.	*Woburn.*
Fox, Henry Heywood, A.B. 1900,	4	Civ. Engin.	*Cambridge.*
Fraser-Campbell, Evan,	2	Mining.	*New York, N. Y.*
Frazer, William James Francis,	1	Mining.	*Boston.*
Frye, John Howard,	1	Mining.	*Cambridge.*
Fuller, Robert Gorham,	4	Gen. Sci.	*Brookline.*
Furness, Douglas Lyle,	3	Elec. Engin.	*Salem.*
Gardner, John Edward,	4	Mech. Engin.	*Exeter, N.H.*
Garfield, Chester Arthur,	4	Gen. Sci.	*Cambridge.*

Garfield, Walter Thompson,	2	Hyg.	*Cambridge.*
Garrett, Julian,	2	Mining.	*Winchester.*
Geeson, Albert Barrot,	1	Gen. Sci.	*Quincy.*
George, David Sanford,	*S.*	Land. Arch.	*Newtown, Conn.*
Giles, Jesse Howard,	1	Civ. Engin.	*Abington.*
Gillette, Ernest Eckert,	3	Gen. Sci.	*Melrose Highlands.*
Gilman, Arthur Eugene,	1	Civ. Engin.	*Medford.*
Gilman, Charles,	4	Civ. Engin.	*Cambridge.*
Gilson, Alden Pinus,	2	Mech. Engin.	*Wellesley Hills.*
Gladman, Cyril Ross Alexander,	1	Arch.	*Lindsay, Ont., Can.*
Good, Albert Edward,	1	Civ. Engin.	*Cambridge.*
Goodrich, Lyman Calvin,	*S.*	Mining.	*No. Adams.*
Gorton, Fred Darwin,	*S.*	Elec. Engin.	*Newton Highlands.*
Gould, Chester Mason,	3	Civ. Engin.	*Lowell.*
Gould, William Matthew, B.S. (*Dalhousie Coll.*) 1901,	3	Elec. Engin.	*Lower Stewiacke, N.S.*
Grant, Harry Johnston,	*S.*	Mining.	*St. Louis, Mo.*
Gregory, William Mumford,	2	Gen. Sci.	*Jonesville, Mich.*
Griffin, Hancock,	1	Gen. Sci.	*New York, N. Y.*
Griffiths, Ralph Fletcher,	2	Civ. Engin.	*Pittsburg, Pa.*
Grimes, Arthur Vincent,	*S.*	Hyg.	*Boston.*
Groves, James Morgan,	3	Gen. Sci.	*Coudersport, Pa.*
Hackett, Leon Abbott,	4	Mech. Engin.	*Auburndale.*
Haggin, Louis Lee,	*S.*	Mining.	*New York, N. Y.*
Hale, Herbert Miller,	4	Civ. Engin.	*Somerville.*
Hall, Barton,	1	Arch.	*Kansas City, Mo.*
Hall, Robert Granville,	2	Hyg.	*Worcester.*
Hall, Theodore Munroe,	1	Forestry.	*Bradford.*
Hamlen, Joseph Rochemont,	2	Gen. Sci.	*Portland, Me.*
Hammatt, Richard Fox,	2	Forestry.	*Hyde Park.*
Hammond, Paul Lyman,	*S.*	Sci. T.	*Scituate.*
Hammond, Roger Noel,	*S.*	Sci. T.	*Scituate.*
Hanavan, William Lawrence, A.B. 1903,	4	Civ. Engin.	*Buffalo, N. Y.*
Hanlon, Thomas Joseph, Jr.	1	Elec. Engin.	*Boston.*
Hansen, Niels M, Jr.	4	Civ. Engin.	*Logan, Utah.*
Hardenbergh, Henry,	4	Chem.	*No. Adams.*
Harrington, Charles Mayo,	*S.*	Arch.	*Worcester.*
Harrison, Edwin Sterne,	4	Civ. Engin.	*St. Louis, Mo.*
Harrison, Walter Thacher,	2	Gen. Sci.	*Braintree.*
Haskell, Adam Leopold, S.B. (*Virginia Polytech. Inst.*) 1902,	4	Mech. Engin.	*Columbia, S.C.*
Hazard, Isaac Peace,	3	Elec. Engin.	*Peace Dale, R.I.*

Head, Natt Samuel,	*S.*	Gen. Sci.	*Battle Lake, Minn.*
Healy, James Joseph, Jr.	*S.*	Chem.	*Newburyport.*
Hedrick, William Archibald,	3	Elec. Engin.	*Salisbury, N. C.*
Heilborn, Jerome Elias,	*S.*	Hyg.	*Brookline.*
Hellmann, Robert Richard,	2	Hyg.	*Cincinnati, O.*
Henderson, John Fletcher,	3	Mech. Engin.	*Johnstown, Pa.*
Hendrickson, Charles John,	*S.*	Elec. Engin.	*Middletown, N. J.*
Henszey, Samuel Alexander, Jr.	1	Elec. Engin.	*Stapleton, N. Y.*
Hersey, Harold Waters,	4	Hyg.	*Hingham.*
Hess, Frank Jaeger,	2	Sci. T.	*Everett.*
Hickey, Charles Hendee,	4	Chem.	*New Dorchester.*
Higginson, James Jackson, Jr.	1	Elec. Engin.	*New York, N. Y.*
Hill, Charles Goodwin,	2	Gen. Sci.	*Worcester.*
Hills, Leon Clark,	2	Mech. Engin.	*Ansonia, Conn.*
Hinton, William Augustus,	3	Gen. Sci.	*Kansas City, Kan.*
Hitchings, Irving Browne,	*S.*	Elec. Engin.	*E. Saugus.*
Hogan, John Philip, A.B. 1903,	4	Gen. Sci.	*Geneva, Ill.*
Holdsworth, Fred,	2	Forestry.	*Fall River.*
Hood, Edward Oakman,	3	Gen. Sci.	*Wellesley Hills.*
Hopkins, Amos Lawrence, 2d,	2	Gen. Sci.	*Washington, D.C.*
Howe, Dudley Rogers,	*S.*	Geology.	*Longwood.*
Howes, Donald Winthrop, S.B. 1903,	4	Civ. Engin.	*Newton.*
Howland, Edward Sands,	1	Civ. Engin.	*Cambridge.*
Hoyle, Alexander Edward, A.B. 1902, A.M. 1903,	4	Arch.	*Concord.*
Hubbard, Robert Arnold,	3	Chem.	*Roxbury.*
Humbert, Frank Utt,	2	Mining.	*Cambridge.*
Hunt, Merrill,	4	Gen. Sci.	*Boston.*
Hunt, William Lloyd,	2	Gen. Sci.	*Cincinnati, O.*
Hurd, William Minot,	4	Gen. Sci.	*Winchester.*
Ireland, Harry Whitcomb,	*S.*	Civ. Engin.	*Littleton.*
Irving, Gugy Æmilius, Jr.	1	Elec. Engin.	*New Brighton, N. Y.*
Iselin, William O'Donnell,	3	Gen. Sci.	*New York, N. Y.*
Jeffery, William Lewis,	3	Elec. Engin.	*Gloucester.*
Jenkins, Lemuel Ray,	1	Mining.	*Revere.*
Jewett, Victor Francis,	2	Gen. Sci.	*Lowell.*
Johnson, Aymar,	2	Gen. Sci.	*New York, N. Y.*
Johnson, Granville, A.B. 1903,	4	Mech. Engin.	*Boston.*
Johnson, Harold Cortez,	3	Gen. Sci.	*Milwaukee, Wis.*
Jones, John Tazewell,	3	Gen. Sci.	*Old Point Comfort, Va.*
Jones, Shadrach Carrington,	1	Civ. Engin.	*Malden.*
Jones, Wallace St. Clair,	3	Elec. Engin.	*Washington, D.C.*

Jopling, Morgan White,	2	Elec. Engin.	*Marquette, Mich.*
Jordan, Wallace Bishop,	2	Civ. Engin.	*Springfield.*
Julian, William Ernest, M.S. (*Southwestern Univ.*) 1900,	4	Gen. Sci.	*Frankford, Tex.*
Katigbak, José Petronio, A.B. (*Univ. of Sto. Tomás*) 1896,	4	Civ. Engin.	*Lipa, Batangas, P.I.*
Keeling, Wilford Henry,	*S.*	Hyg.	*Sioux City, Ia.*
Keith, Edwin,	2	Mech. Engin.	*Bridgewater.*
Kelley, George Leslie,	1	Chem.	*Everett.*
Kellogg, Harold Field,	2	Arch.	*Cambridge.*
Kellogg, Henry Johonnott,	2	Chem.	*Winchester.*
Kelly, John Vincent,	2	Mining.	*Newton.*
Kelsey, Paul Henry, A.B. 1902,	*S.*	Hyg.	*Cambridge.*
Kent, William, Jr.	2	Gen. Sci.	*Tuxedo, N.Y.*
Kernan, Hubert Dolbeare,	3	Mech. Engin.	*Alder Creek, N.Y.*
Kersburg, Harry Edwin,	1	Mining.	*Medina, N.Y.*
Kesselhuth, Frederick Augustus,	2	Mining.	*Roslindale.*
Keyser, George Depue,	3	Civ. Engin.	*Salt Lake City, Utah.*
Kilmer, Frederick Mills, Jr.	4	Gen. Sci.	*Somerville.*
Kimball, Bernard Marshall,	*S.*	Mech. Engin.	*Littleton.*
Kimball, Ernest Robbins,	2	Civ. Engin.	*Somerville.*
King, Moses, Jr.	4	Elec. Engin.	*New York, N.Y.*
Kipper, Herman Brunswick,	4	Gen. Sci.	*Adams.*
Knowlton, Arthur Reid,	2	Chem.	*Rockport.*
Kober, Philip Adolf,	2	Chem.	*Freedom, Pa.*
Kohler, Charles Wendell,	*S.*	Chem.	*Arlington.*
Krokyn, Jacob Frederick, A.B. 1903,	3	Arch.	*Boston.*
Lander, Frederick Charles,	1	Mining.	*Cambridge.*
Langley, William Basil,	*S.*	Civ. Engin.	*Waltham.*
Lawson, Carl,	3	Civ. Engin.	*Auburndale.*
Lawton, William Ross, PH.B. (*Brown Univ.*) 1903,	2	Arch.	*Providence, R.I.*
Leatherbee, Frederic Keith,	*S.*	Biology.	*W. Newton.*
Lee, Charles Creighton,	2	Mech. Engin.	*New York, N.Y.*
LeMoyne, Henry,	1	Mining.	*Brookline.*
Leonard, Nahum,	3	Sci. T.	*Bridgewater.*
Leonard, Philip Haskell,	*S.*	Mining.	*Boston.*
Lester, Daniel Henry,	4	Gen. Sci.	*Bradford, Pa.*
Levine, Joseph Malcolm,	2	Civ. Engin.	*Boston.*
Lewis, James Bradford, Jr.	2	Mining.	*Walpole.*
Lewis, John Robert,	3	Gen. Sci.	*Hoosick Falls, N.Y.*
Lilienthal, Albert Max, Jr.	1	Elec. Engin.	*New York, N.Y.*

Lindsley, Thayer, A.B. 1903,	4	Civ. Engin.	*Milton.*
Lipsky, Harold,	1	Hyg.	*Roxbury.*
Little, William Morton,	1	Mining.	*Winchester.*
Locke, Augustus,	3	Mining.	*No. Adams.*
Long, Joseph Abraham,	4	Biology.	*Allegheny, Pa.*
Loomis, Dudley Lathrop,	3	Gen. Sci.	*Brookline.*
Lovell, Walter,	1	Mining.	*W. Newton.*
Lupien, Ulysses John,	1	Mech. Engin.	*Cochituate.*
Lutz, Roger Henry,	1	Biology.	*Dedham.*
Lyman, James Otis,	2	Civ. Engin.	*Bellport, N. Y.*
McAllister, Daniel Bruno,	*S.*	Mech. Engin.	*Boston.*
McArthur, Albert Chase,	2	Gen. Sci.	*Chicago, Ill.*
McAusland, Andrew Roy,	1	Hyg.	*Taunton.*
McCartney, William Singerly,	2	Gen. Sci.	*Philadelphia, Pa.*
McClinton, Donald Nesbit,	4	Mech. Engin.	*Steubenville, O.*
McClure, Graham Traquair,	1	Gen. Sci.	*Philadelphia, Pa.*
McDewell, Horatio Sprague,	*S.*	Mech. Engin.	*Brookline.*
Macdonald, William Griffith,	*S.*	Gen. Sci.	*Troy, N. Y.*
McGirr, Edward Bartholomew,	*S.*	Arch.	*Cambridge.*
McNally, Thomas Edwin,	1	Elec. Engin.	*New York, N. Y.*
McNamara, James Martin,	2	Sci. T.	*Fitchburg.*
Macy, Arthur Warren,	1	Civ. Engin.	*Cambridge.*
Mallett, Fowler,	1	Arch.	*San Francisco, Cal.*
Manahan, Paul Revere,	1	Chem.	*Boston.*
Margolin, Louis,	4	Forestry.	*New York, N. Y.*
Mark, Clarence,	2	Gen. Sci.	*Chicago, Ill.*
Markowitz, Alfred Junius,	*S.*	Civ. Engin.	*Boston.*
Marsters, Charles Elbert,	1	Civ. Engin.	*Brooklyn, N. Y.*
Marvin, Joseph Benson, Jr.	3	Gen. Sci.	*Louisville, Ky.*
Mason, Harry Elward,	1	Elec. Engin.	*Charlestown.*
Mason, James Servetus, 3d,	4	Gen. Sci.	*Germantown, Pa.*
Maxson, Julian Wells,	*S.*	Gen. Sci.	*Westerly, R.I.*
May, Henry Coleman,	*S.*	Arch.	*Washington, D.C.*
Mead, Augustus,	1	Gen. Sci.	*Greenwich, Conn.*
Mendelsohn, Charles,	3	Mining.	*Boston.*
Merrill, Roger,	*S.*	Mining.	*Boston.*
Milinowski, Arthur Siegfried,	4	Gen. Sci.	*Hamburg, N.J.*
Moffatt, George Tufton,	*S.*	Gen. Sci.	*Cambridge.*
Monks, Archibald Greenough,	4	Mech. Engin.	*Brookline.*
Montoulieu de Latorre, Edward, A.B. (*Havana Univ.*) 1898,	4	Mining.	*Puerto Principe, Cuba.*
Montoulieu de Latorre, Henry, A.B. (*Havana Univ.*) 1897,	4	Civ. Engin.	*Puerto Principe, Cuba.*

Moore, Fred Porter,	3	Hyg.	*Cambridge.*
Moore, George Albert,	1	Hyg.	*North Monroe, N.H.*
Moore, James Clyde,	4	Gen. Sci.	*W. Stockbridge.*
Moore, Lucas William,	1	Gen. Sci.	*New Orleans, La.*
Morgan, Henry,	3	Elec. Engin.	*New York, N. Y.*
Morgan, James Cutler,	*S.*	Mining.	*Cambridge.*
Morrill, Ashley Baker,	1	Hyg.	*Concord, N.H.*
Moses, Percy Lawrence,	2	Elec. Engin.	*Boston.*
Movius, Hallam Leonard,	*S.*	Land. Arch.	*Buffalo, N. Y.*
Moynahan, James Joseph,	3	Civ. Engin.	*New York, N. Y.*
Muir, Philip Howie,	2	Gen. Sci.	*Detroit, Mich.*
Mundo, Charles Joseph,	1	Elec. Engin.	*Roxbury.*
Munn, Eugene Ellis,	1	Mining.	*Fitchburg.*
Murphy, Francis Joseph,	2	Civ. Engin.	*Charlestown.*
Murphy, Frederick William,	2	Chem.	*New Dorchester.*
Murray, Milton,	*S.*	Civ. Engin.	*Springfield.*
Myers, George Kendall,	*S.*	Hyg.	*Roxbury.*
Nash, Herbert, Jr.	2	Gen. Sci.	*Boston.*
Neil, Frederick, B.A.S. 1903,	4	Land. Arch.	*New Dorchester.*
Nelson, Theodore,	4	Gen. Sci.	*Newton Centre.*
Newell, George Russell,	3	Civ. Engin.	*Rochester, N. Y.*
Newhall, Alfred Seymour,	1	Gen. Sci.	*Lynn.*
Newhall, Francis Watriss,	2	Gen. Sci.	*Jamaica Plain.*
Newman, Bruno,	2	Mining.	*Dorchester.*
Newman, James Arthur,	1	Mining.	*Winchester.*
Nichols, Harold Willis,	1	Mining.	*Haverhill.*
Nickerson, Harold,	2	Gen. Sci.	*Lowell.*
Nolan, John Joseph Aloysius,	1	Arch.	*Somerville.*
Nolen, John, PH.B. (*Univ. of Pennsylvania*) 1893,	2	Land. Arch.	*Cambridge.*
Noyes, David Chester,	*S.*	Mech. Engin.	*Boston.*
Noyes, Stephen Henley, A.B. 1903,	3	Civ. Engin.	*Newport, R.I.*
Nurenburg, Lewis Irving,	2	Hyg.	*Roxbury.*
Nutting, Philip Albert,	1	Mech. Engin.	*Cambridge.*
Oaks, Henry Lane,	*S.*	Elec. Engin.	*So. Framingham.*
O'Brian, Roland Lord,	*S.*	Mech. Engin.	*Buffalo, N. Y.*
O'Brien, Paul,	4	Hyg.	*Pittsburg, Pa.*
O'Donnell, Charles Jerome,	1	Civ. Engin.	*E. Boston.*
Oelrichs, Charles de Loosey,	2	Gen. Sci.	*Newport, R.I.*
Olds, Norman Evry,	2	Civ. Engin.	*Fort Wayne, Ind.*
Osgood, Edward Holyoke,	3	Arch.	*Salem.*
Otero y Galarraga, Ralph, A.B. (*Havana Univ.*) 1898,	*S.*	Arch.	*Havana, Cuba.*

Owens, Hiram Hercules, S.B. (*Williamsburg Inst.*) 1900,	4	Sci. T.	*Coalport, Ky.*
Packard, Leonard Oscar,	4	Gen. Sci.	*Rockville, Me.*
Pachtz, Arthur Julius,	2	Elec. Engin.	*Dorchester.*
Page, James Goodridge,	4	Gen. Sci.	*Bradford.*
Page, Maurice Joel,	*S.*	Mining.	*Newton Highlands.*
Paige, Clifton Harlan, B.A.S. (*Bussey Institution*) 1902,	4	Land. Arch.	*Cambridge.*
Palmer, Howard Salem,	1	Elec. Engin.	*Winchester.*
Parker, Henry Cooper,	2	Mining.	*Wellsville, Utah.*
Paton, Arthur David,	4	Chem.	*Yonkers, N. Y.*
Paton, Hugh Swale,	2	Arch.	*Yonkers, N. Y.*
Patterson, Philip Merrill,	3	Elec. Engin.	*Arlington Heights.*
Peabody, Robert Manning,	2	Mining.	*St. Louis, Mo.*
Peirce, Edwin Hoyt,	4	Gen. Sci.	*Everett.*
Pellissier, Robert Edouard,	4	Gen. Sci.	*Brooklyn, N. Y.*
Pemberton, Frank Arthur,	2	Hyg.	*Auburndale.*
Peters, George Anton,	2	Gen. Sci.	*Newport, R. I.*
Pettebone, Lauren Augustus,	3	Gen. Sci.	*Buffalo, N. Y.*
Pleasonton, Frank Rodney,	*S.*	Mech. Engin.	*Philadelphia, Pa.*
Pomeroy, Henry King,	*S.*	Biology.	*Chicago, Ill.*
Poor, Frederic Hedge, S.B. 1903,	4	Elec. Engin.	*Morristown, N. J.*
Pope, Robert Anderson,	3	Land. Arch.	*Newburyport.*
Poulterer, William Taylor,	1	Mech. Engin.	*Philadelphia, Pa.*
Pratt, Horatio Whittemore,	3	Hyg.	*Grafton.*
Pritchard, Harold William,	4	Gen. Sci.	*Newbury.*
Proal, Pierre Alexis,	2	Gen. Sci.	*New York, N. Y.*
Prodromos, Aristotle Hodge,	2	Elec. Engin.	*Boston.*
Purcell, Herbert William,	2	Elec. Engin.	*Somerville.*
Quackenbush, Harry Sargeant,	2	Elec. Engin.	*Schenectady, N. Y.*
Quigley, William Sullivan,	1	Hyg.	*Charlestown.*
Quinlan, John Vincent,	1	Elec. Engin.	*Brookline.*
Rafferty, Donald George,	1	Hyg.	*Pittsburg, Pa.*
Rand, Roland Bradbury,	2	Civ. Engin.	*Kendal Green.*
Rankin, Louis Giffin,	1	Hyg.	*Pittsburg. Pa.*
Ray, Edward Russel,	3	Arch.	*Evanston, Ill.*
Read, Homer Taft,	2	Gen. Sci.	*Winchester.*
Read, Warren Kempton,	1	Civ. Engin.	*New Bedford.*
Redding, Michael Joseph,	*S.*	Elec. Engin.	*So. Boston.*
Reggio, André Nicholas,	1	Gen. Sci.	*Boston.*
Reilly, Leo Bayles,	1	Elec. Engin.	*Roxbury.*
Richards, Joshua Merrill,	3	Mining.	*Boston.*
Richardson, Guy Brooks,	2	Gen. Sci.	*Lowell.*

Richardson, Henry Allen,	1	Mech. Engin.	*Rockport.*
Richardson, Walter Myrick,	4	Land. Arch.	*Leominster.*
Richmond, Ralph Sumner,	1	Gen. Sci.	*Little Compton, R.I.*
Richmond, Winthrop Cushing,	2	Forestry.	*Brookline.*
Risley, Arthur Leroy,	2	Gen. Sci.	*Newburyport.*
Roberts, David, Jr.	2	Gen. Sci.	*Birmingham, Ala.*
Roberts, Henry Knowlton,	4	Gen. Sci.	*Salem.*
Rodman, Frank Clark,	2	Gen. Sci.	*Roxbury.*
Rogers, John Laurence,	2	Gen. Sci.	*Cambridge.*
Rollins, Ashton,	2	Forestry.	*Dover, N.H.*
Ross, Louis, A.B. 1903,	4	Civ. Engin.	*Cambridge.*
Ross, Percy Harrison,	1	Chem.	*W. New Brighton, N.Y.*
Rossiter, Kensett,	*S.*	Arch.	*New York, N.Y.*
Roth, Edward, Jr.	2	Civ. Engin.	*Vineyard Haven.*
Rowe, Edward Prescott,	3	Gen. Sci.	*Boston.*
Russell, Charles Abraham,	*S.*	Arch.	*New Bedford.*
St. George, William,	*S.*	Elec. Engin.	*Waltham.*
Sampson, Edwin Field,	2	Gen. Sci.	*Newtonville.*
Sampson, Winslow Francis,	2	Mech. Engin.	*Newtonville.*
Sanders, Thomas, 2d,	2	Gen. Sci.	*Salem.*
Sanford, Huntington,	1	Mining.	*Dorchester.*
Sanger, Walter Prentice,	*S.*	Arch.	*Washington, D.C.*
Sargent, William Denny,	2	Mech. Engin.	*Swampscott.*
Scanlan, Walter Leo,	*S.*	Mining.	*Dorchester.*
Schoenfuss, Frank Hermann,	3	Mining.	*Jamaica Plain.*
Scholl, Guilford Darby,	2	Mining.	*Reading, Pa.*
Scott, Christopher Pearse,	1	Mech. Engin.	*Burlington, Ia.*
Scott, Lorne Albert,	4	Biology.	*Dorchester.*
Sears, Thomas Warren, A.B. 1903,	2	Land. Arch.	*Brookline.*
Shaw, Arthur Wyman,	1	Civ. Engin.	*Bridgewater.*
Shaw, Howard Rutherford,	1	Mech. Engin.	*Cambridge.*
Shaw, John Daniel,	*S.*	Land. Arch.	*Roxbury.*
Shaw, John Maxwell, Jr.	2	Gen. Sci.	*Indianapolis, Ind.*
Sheldon, Reginald Herbert,	1	Elec. Engin.	*No. Chelmsford.*
Sherburne, Edward Harold,	2	Gen. Sci.	*Brookline.*
Shirk, Franklin Edgar,	*S.*	Geology.	*Muncie, Ind.*
Sickles, Raymond,	*S.*	Civ. Engin.	*Trenton, N.J.*
Siddall, Joseph,	*S.*	Elec. Engin.	*Trenton, N.J.*
Silverman, Nathaniel Lawrence,	2	Gen. Sci.	*Boston.*
Silverman, Peyser Edward,	2	Mech. Engin.	*Boston.*
Simpkins, Harold Winslow,	1	Gen. Sci.	*St. Louis, Mo.*
Skelley, Robert Douglas,	3	Mining.	*Riverside, Cal.*
Skene, Harold Vincent,	2	Land. Arch.	*Somerville.*

Skillings, Joseph Kingsley,	1	Arch.	*Malden.*
Smith, Allan,	3	Mech. Engin.	*E. Dedham.*
Smith, Eliot Nichols, A.B. (*Oberlin Coll.*) 1900,	4	Civ. Engin.	*Berlin, Conn.*
Smith, Harold Crocker,	2	Gen. Sci.	*Fall River.*
Smith, Harry Wilber, A.B. (*Hedding Coll.*) 1900,	4	Mech. Engin.	*Abingdon, Ill.*
Smith, Julius Frederic,	2	Gen. Sci.	*St. Johnsville, N. Y.*
Smith, Lyon,	2	Gen. Sci.	*Brookline.*
Smith, Sidney McKeehan,	*S.*	Mining.	*Wellsville, O.*
Smith, Thomas Dickson,	*S.*	Biology.	*Brookline.*
Smither, Robert Newkirk,	2	Elec. Engin.	*Buffalo, N.Y.*
Snyder, Otto von Schrader,	1	Elec. Engin.	*Wellesley Hills.*
Souther, Channing Weare,	2	Gen. Sci.	*Jamaica Plain.*
Souther, Dana Wheelock,	2	Gen. Sci.	*Jamaica Plain.*
Sprague, Starbuck,	*S.*	Elec. Engin.	*No. Cambridge.*
Stark, John Vassar,	1	Civ. Engin.	*Penn Yan, N.Y.*
Starr, Samuel,	*S.*	Hyg.	*Boston.*
Starratt, Stanley Arthur,	4	Biology.	*Cambridge.*
Stevens, Edward Addison, Jr.	4	Elec. Engin.	*Lowell.*
Stevens, Ervin Maling,	*S.*	Mech. Engin.	*Portland, Me.*
Stevenson, Geoffrey,	2	Gen. Sci.	*Buffalo, N.Y.*
Stevenson, George Harrison,	*S.*	Chem.	*New Haven, Conn.*
Stewart, James Robertson,	3	Civ. Engin.	*Cincinnati, O.*
Stewart, Robert Bentley,	*S.*	Mining.	*Youngstown, O.*
Stickney, William White,	2	Arch.	*Pueblo, Colo.*
Stilwell, Edwin Ruthven,	*S.*	Mech. Engin.	*Dayton, O.*
Stoltz, Guy Calvin,	*S.*	Mining.	*Marion, O.*
Stone, Walter Maxwell,	4	Mech. Engin.	*Waltham.*
Street, Paul Bishop,	2	Mining.	*Toronto, Can.*
Streeter, Daniel Willard,	1	Mining.	*Buffalo, N. Y.*
Sturges, Harry Wilton,	*S.*	Elec. Engin.	*New York, N.Y.*
Sugden, Gilbert Taylor,	1	Civ. Engin.	*Amsterdam, N.Y.*
Sullivan, John Stephen Berchmans,	1	Elec. Engin.	*Cambridge.*
Sullivan, Richard Thomas,	2	Elec. Engin.	*Newton Upper Falls.*
Sumner, Louis Worsley,	3	Hyg.	*Cambridge.*
Sutton, William, Jr.	*S.*	Mech. Engin.	*No. Andover.*
Swain, Frank Brown,	*S.*	Arch.	*Brockton.*
Swarts, Gardner Taber, Jr.	1	Civ. Engin.	*Providence, R.I.*
Swift, Leroy Fenwick,	3	Sci. T.	*Bourne.*
Swift, Rodman,	4	Mining.	*New Bedford.*
Taft, Waterman Allen, Jr.	2	Gen. Sci.	*Arlington.*

Talpey, Alfred Henry Eugene,	2	Elec. Engin.	*Dorchester.*
Tanner, Freeman,	*S.*	Civ. Engin.	*Provo, Utah.*
Taylor, George Francis, S.B. (*Utah Agric. Coll.*) 1900,	4	Civ. Engin.	*Plain City, Utah.*
Taylor, George Philip,	2	Chem.	*Boston.*
Taylor, William Nicholson,	4	Gen. Sci.	*Pittsburg, Pa.*
Tenney, Frank Chester,	*S.*	Chem.	*Jamaica Plain.*
Tew, James Dinsmore,	3	Mining.	*Jamestown, N.Y.*
Thanisch, Rudolph Joseph,	3	Gen. Sci.	*Jamaica Plain.*
Thayer, Abbot Augustine,	4	Mech. Engin.	*Cincinnati, O.*
Thomas, Walter Grant,	1	Arch.	*Wollaston.*
Thompson, Eugene Lloyd,	1	Hyg.	*Winamac, Ind.*
Thompson, Edward Orton,	2	Gen. Sci.	*Cambridge.*
Thompson, James Lawton,	*S.*	Arch.	*Portland, Me.*
Thompson, Warren Dunham,	1	Mining.	*Brookline.*
Thomson, Robert Douglas,	*S.*	Elec. Engin.	*Lynn.*
Thurlow, Edward Kimball,	2	Land. Arch.	*W. Newbury.*
Thurlow, Merriam McIntyre,	3	Mining.	*Colorado Springs, Colo.*
Tirrell, Charles Edwards,	4	Mech. Engin.	*So. Weymouth.*
Titcomb, Albert Clement,	1	Gen. Sci.	*Newburyport.*
Tolman, Samuel Albert,	3	Gen. Sci.	*New Dorchester.*
Townsend, Richard Sullivan,	1	Gen. Sci.	*Brookline.*
Train, Arthur Herman,	3	Mech. Engin.	*Weston.*
Turner, Chester Bidwell,	3	Land. Arch.	*Roxbury.*
Tuttle, Ralph Weare,	4	Hyg.	*E. Andover, N.H.*
Tyer, Henry George,	1	Chem.	*Andover.*
Ulrich, John Linck,	*S.*	Biology.	*Brooklyn, N.Y.*
Updegraff, William Barrett,	*S.*	Mech. Engin.	*Newburgh, N.Y.*
Upton, George,	2	Chem.	*Salem.*
Van Winkle, Edgar Beach, Jr.	4	Arch.	*New York, N.Y.*
Varney, Ralph Wesley,	2	Arch.	*Boston.*
Wade, Levi Clifford,	*S.*	Gen. Sci.	*Newton Centre.*
Wade, William Rogers,	4	Mining.	*Newton Centre.*
Walcott, Stuart Lanier,	*S.*	Hyg.	*New York Mills, N.Y.*
Wales, Nathaniel Brackett,	2	Gen. Sci.	*Braintree.*
Wallace, Robert,	2	Mining.	*Newton.*
Walworth, George Roberts, PH.B. (*Brown Univ.*) 1903,	4	Gen. Sci.	*Newton Centre.*
Ward, Neil Callen,	*S.*	Elec. Engin.	*Greenfield, Tenn.*
Warner, Arthur Linus Dudley,	*S.*	Mech. Engin.	*Syracuse, N.Y.*
Warren, Harry Edward,	4	Arch.	*W. Somerville.*
Webber, Charles Jewell,	3	Gen. Sci.	*Bangor, Me.*
Webber, Philip Rockwood,	*S.*	Mining.	*Winchester.*

Webber, Ralph Flewelling,	2	Chem.	*Winchester.*
Webster, Lawrence Burns,	2	Gen. Sci.	*Marion, Ind.*
Weiskopf, Maurice Fox,	1	Chem.	*Cincinnati, O.*
Wellington, Charles Oliver,	1	Mining.	*Newton.*
Wells, Pearson,	3	Gen. Sci.	*Milwaukee, Wis.*
Wells, Percy Addison,	2	Civ. Engin.	*Chicago, Ill.*
Wendell, Evert Jansen, 2d,	1	Land. Arch.	*Wayne, Pa.*
West, Frederick Orra,	3	Hyg.	*Woburn.*
West, John Briggs, Jr.	2	Gen. Sci.	*Cambridge.*
Weymouth, Frederick Abbott,	1	Elec. Engin.	*No. Cambridge.*
Whalen, Arthur Frank,	*S.*	Elec. Engin.	*Melrose Highlands.*
Wheeler, Reginald Tremaine,	3	Gen. Sci.	*Buffalo, N. Y.*
Whidden, Thomas Avery,	2	Gen. Sci.	*W. Newton.*
White, Bryant,	3	Elec. Engin.	*Louisville, Ky.*
White, Edwin Ellis,	3	Mining.	*Hyde Park.*
White, William Wiley,	*S.*	Mech. Engin.	*Cambridge.*
Whitlock, Julius Lawton,	1	Mining.	*Calais, Me.*
Whitney, Robert Bates, A.B. 1902,	1	Land. Arch.	*Dorchester.*
Wilbur, Robert Eldredge,	1	Arch.	*So. Bethlehem, Pa.*
Willard, Henry Bowers,	2	Arch.	*New York, N. Y.*
Williams, Haskell,	1	Gen. Sci.	*Worcester.*
Williams, Malcolm,	*S.*	Gen. Sci.	*Boston.*
Williams, Warren,	1	Gen. Sci.	*Worcester.*
Winslow, Sidney Wilmot, Jr.	2	Gen. Sci.	*Beverly.*
Woodbridge, Robert Stewart,	*S.*	Mining.	*New York, N. Y.*
Woodbury, Francis Prescott,	*S.*	Gen. Sci.	*Newburyport.*
Woodbury, Robert Lawrence,	*S.*	Civ. Engin.	*Allston.*
Woodfin, Howard Fisher,	1	Mech. Engin.	*Rutland, Vt.*
Woods, Morrill Chalmers,	*S.*	Elec. Engin.	*Cambridge.*
Woodward, George Smith,	2	Sci. T.	*Springfield.*
Woodworth, Robert Newton,	3	Gen. Sci.	*Cambridge.*
Wright, David Clarence,	4	Elec. Engin.	*Cleveland, O.*
Wright, William Merritt, Jr.	*S.*	Gen. Sci.	*Washington, D.C.*
Wylie, Sims Gill,	*S.*	Hyg.	*New York, N. Y.*
Wyndham-Gittens, Herbert Strathmore,	2	Mech. Eng.	*Hastings, Barbadoes,* [*W.I.*

SUMMARY.

Fourth Year Students	95
Third " "	75
Second " "	149
First " "	117
Special "	126
Total	562

Civil Engineering	74
Mechanical Engineering	53
Electrical Engineering	74
Mining and Metallurgy	72
Architecture	42
Landscape Architecture	18
Forestry	8
Chemistry	25
Geology	3
Biology	14
Anatomy and Physiology	36
For Teachers of Science	13
General Science	130
Total	562

HOLDERS OF SCHOLARSHIPS

1903–04.

Eveleth.

Charles Gilman.
Herbert Miller Hale.
Charles Mendelsohn.

Hilton.

Charles Heber Fisher.

Jennings.

Frederick Mills Kilmer, Jr.

L. S. S. Association.

James Clyde Moore.

Normal School.

Leonard Oscar Packard.
Robert Edouard Pellissier.
George Smith Woodward.

University.

John Heath Bucke.
Gustavus Chambers Crawford.
William Bell Dinsmoor.
John Edward Gardner.
Philip Merrill Patterson.
Roland Bradbury Rand.

Emerson.

Frank Utt Humbert.
Joseph Abraham Long.
Guilford Darby Scholl.

DEGREES.

On Commencement Day, June 29, 1904, the degree of S.B. was conferred as follows: —

In Civil and Topographical Engineering.

Edwards, Dean Gray, A.B. (*magna cum laude*).

Fox, Henry Heywood, A.B. (*magna cum laude*).

Gilman, Charles (*magna cum laude*).

Hale, Herbert Miller (*magna cum laude*).

Hanavan, William Lawrence, A.B.

Hansen, Niels M., Jr.

Harrison, Edwin Sterne.

Howes, Donald Winthrop, S.B. (*cum laude*).

Katigbak, José Petronio, A.B.

Lindsley, Thayer, A.B. (*cum laude*).

Montoulieu de Latorre, Henry, A.B. (*cum laude*).

Smith, Eliot Nichols, A.B. (*magna cum laude*).

Taylor, George Francis, S.B.

In Mechanical Engineering.

Hackett, Leon Abbott.

Johnson, Granville, A.B. (*cum laude*).

McClinton, Donald Nesbit (*magna cum laude*).

Smith, Harry Wilber, A.B. (*cum laude*).

Stone, Walter Maxwell (*cum laued*).

Thayer, Abbott Augustine (*cum laude*).

In Electrical Engineering.

Barnes, Donald Carter, A.B. (*magna cum laude*).

Crawford, Gustavus Chambers, A.B., A.M. (*cum laude*).

Fisher, Charles Heber (*magna cum laude*).

Poor, Frederic Hedge, S.B.

Stevens, Edward Addison, Jr. (*cum laude*).

Wright, David Clarence (*cum laude*).

In Mining and Metallurgy.

DeLong, Harold Clark.

Montoulieu de Latorre, Edward, A.B. (*cum laude*).

Parker, Henry Cooper.

Swift, Rodman (*cum laude*).

Wade, William Rogers (*cum laude*).

In Architecture.

Hoyle, Alexander Edward, A.B., A.M. (*cum laude*).

Van Winkle, Edgar Beach, Jr.

Varney, Ralph Wesley (*cum laude*).

Warren, Henry Edward (*magna cum laude*).

In Forestry.

Margolin, Louis (*cum laude*).

In Chemistry.

Hardenbergh, Henry.

Paton, Arthur David.

In Biology.

Copeland, Manton (*cum laude*).
Long, Joseph Abraham (*magna cum laude*).
Scott, Lorne Albert.
Starratt, Stanley Arthur (*cum laade*).

In Anatomy and Physiology.

Hersey, Harold Waters.

In Teachers of Science.

Adams, Matthew Prior (*cum laude*).
Fenno, Stanley Warner.
Owens, Hiram Hercules, S.B.

In General Science.

Adams, Arthur Kinney.
Bauer, Frank Robert.
Bickley, Lloyd Wharton.
Blodgett, John Henry.
Blossom, Carl Woodruff.
Carroll, Michael Davitt (*cum laude*).
Clark, Thomas Roy.
Collings, George Boswell Morey.
Crane, Richard Teller, 3d.
Dudley, John Charles.
Ellis, Theodore Hickling.
Ely, Frederick Burchard.
Fuller, Robert Gorham.
Garfield, Chester Arthur.
Gregory, William Mumford.
Hogan, John Philip, A.B.
Hunt, Merrill.
Julian, William Ernest, M.S.
Kipper, Herman Brunswick (*cum laude*).
Lester, Daniel Henry.
Mason, James Servetus, 3d.
Milinowski, Arthur Siegfried.
Moore, James Clyde (*cum laude*).
Nelson, Theodore,
Newhall, Francis Watriss.
Packard, Leonard Oscar (*magna cum laude*).
Page, James Goodridge.
Peirce, Edwin Hoyt.
Pellissier, Robert Edouard (*cum laude*).
Pritchard, Harold William.
Roberts, Henry Knowlton.
Thanish, Rudolph Joseph.
Ward, Howard Ridgely.
Woodworth, Robert Newton.

THE LAWRENCE SCIENTIFIC SCHOOL.

GENERAL ACCOUNT OF THE SCHOOL.

The Scientific School was instituted by the Corporation and Overseers of Harvard College in February, 1847. It took its present name — Lawrence Scientific School — at the following Commencement, in recognition of a gift of fifty thousand dollars from the Hon. Abbott Lawrence, of Boston. It was opened to students in February, 1848. It was at first announced as an advanced school in Science and Literature for graduates and other sufficiently qualified persons of not less than eighteen years of age, and was, therefore, in its origin, a forerunner of the Graduate School. Most of its early students were college graduates or men of mature age who came to the School for the professional study of a special subject. The instruction originally proposed in Literature was, however, never organized. It is now a school which receives suitably prepared graduates of secondary schools, as well as older students, and offers chiefly training in the various branches of natural and applied science. Its students may attain the degree of Bachelor of Science.

The Lawrence Scientific School, together with Harvard College and the Graduate School, is under the control of the Faculty of Arts and Sciences of Harvard University. The instruction in these departments is given by the same teachers, mostly in classes which may be attended by pupils from any one of these schools. The life of the students in all three schools is in common; they share alike in all the advantages which the University can afford them. So far as their plans may make it desirable, they are allowed, without additional charge, to attend lectures in the professional schools of the University.

The essential peculiarity of the Scientific School, as compared with the other schools which are managed by the Faculty of Arts and Sciences, is that the instruction which it provides for its students is, for the most part, arranged in groups of definitely required programmes of courses, each of which is intended to afford, in a four years' course of study, the training necessary for one of the scientific professions, such as Engineering, Mining, Architecture, Forestry, Chemistry, Biology, Geology, etc. While, with the consent of the Administrative Board of the School, slight changes may be made in the prescribed studies in order to meet the particular needs of the individual student, the plan of these programmes leading to the degree of Bachelor of Science must in general be adhered to.

Students attending the School may lodge in the dormitories or in private houses, lists of which will be furnished on application to the Secretary. They may take their meals in Memorial Hall, which affords accommodation for about 1100 persons; or in Randall Hall, which provides for about 800; or in private boarding houses.

ADVISER.

Each student in the Scientific School has one of its officers designated as his adviser, to whom he is to look for counsel concerning the conduct of his studies and for such other counsel as he may need during his residence at the University.

INSTRUCTION IN OTHER DEPARTMENTS OF THE UNIVERSITY.

All students of the Scientific School may, if found competent, pursue any of the courses of instruction given in the other departments of the University, except exercises carried on in the special laboratories, without additional charge; but this provision does not apply to Special Students unless they pay the full tuition fee of $150. See p. 7.

REGULATIONS CONCERNING ADMISSION EXAMINATIONS.

Examinations.

A student who wishes to enter the Lawrence Scientific School as a candidate for a degree must ordinarily pass an examination for admission; but if he comes from another college or scientific school, he may be admitted without examination (see page 43).

Special Students, that is, students not candidates for a degree, may be admitted without examination (see page 44).

Examinations for admission to the Lawrence Scientific School are held in June both at Cambridge and at the places named on pages 69, 70; in September they are held at Cambridge only. For the regulations concerning the division of the examination into a Preliminary and a Final Examination, taken in two different years, or — in the case of a student who takes the whole examination in *one* year — the division of the Final Examination between June and September of that year, see pages 42, 43.

For the hours set for examinations, see page 69.

The requirements for admission to the First-year class are stated on page 47.

The definitions of the studies in which admission examinations are held are given on pages 49–68.

Registration Blanks.

Any one expecting to take admission examinations should register for such examinations on a form which may be obtained from the Secretary. When writing for this form he should say whether he is a Preliminary or a Final Candidate. The Registration Blanks of all candidates who wish to take examinations in June should be properly filled out and in the hands of the Secretary by June 10; those of candidates who wish to take examinations in September, by September 10.

Certificate of Honorable Dismissal.

Every candidate for admission to the Lawrence Scientific School is required to furnish a certificate of honorable dismissal from the school or college which he has attended, or from the tutor with whom he has studied. When a candidate has been in regular attendance at a school or academy for any part of the year preceding his Final Examination, a certificate from a private tutor is not in itself sufficient. The certificate of honorable dismissal may be presented at the time of the Final Examination.

Certificate of Preparation for Examination.

Every candidate for a Preliminary Examination must present a certificate of preparation in the subjects in which he offers himself. (For the prescribed form of this certificate, see page 42.)

No certificate of preparation is required of a candidate for a Final Examination, even when the candidate divides his examination between June and September of one year.

Examination Fee.

A fee of five dollars must be paid *in advance* by every candidate. **One fee only** is required, and this should be paid before the first examination the candidate takes. The whole fee of a candidate who purposes to divide his examination is to be paid before his first examination : the fee should be sent by check, post-office order, or registered letter, to Charles F. Mason, Bursar, Dane Hall, Cambridge, Mass., and should be in the Bursar's hands not later than *June 10*. The sender of this fee should be careful to name the candidate for whom the fee is paid, and the place at which the candidate will take his examinations.

Persons who do not intend to enter the University will be admitted to the examinations on payment of a fee of five dollars; and, if successful in fulfilling the requirements for the Lawrence Scientific School, will receive a certificate to that effect.

Division of the Examination.

A candidate for admission to the Lawrence Scientific School may take the entire examination at one time; or he may divide it, under the following conditions, (*a*) between two years, or (*b*) between June and September of the same year, or (*c*) between June of one year and June and September of a second year. If he divides it between two years, he is known at his first examination as a "Preliminary Candidate"; if he divides his whole examination between June and September of the same year, or, having passed a Preliminary Examination, he divides the examination of the second year between June and September of that year, he is known as a "Postponing Candidate." Teachers and candidates should carefully distinguish between the words "Preliminary" and "Postponing" as used at examinations for admission, since a careless use of one of these words for the other leads to serious misunderstanding. A Preliminary Examination is always taken a year or more before the Final Examination. Postponing Candidates, whether in September or in June, are taking Final Examinations.

(*a*) Preliminary Examination.

A candidate may pass a Preliminary Examination on some studies in one year; and, on receiving a Preliminary Certificate, may pass a Final Examination in the remaining studies in some subsequent year. For the Preliminary Examination the candidate is expected to present himself in June, having previously sent in a certificate of preparation (see below). No Preliminary Candidate for the Scientific School will be examined in September without special permission from the Dean of the Scientific School.

Candidates may offer themselves for the Preliminary Examination in any studies, Elementary or Advanced, *in which their teachers certify that they are prepared, and in no others.*

On the Registration Blank (see p. 41), which must be in the hands of the Secretary by June 10, is printed the following form: —

" .... has been my pupil for .... years, and is, in my judgment, prepared to pass the Harvard Preliminary Examination in the following studies: — . . .
Name of Teacher: .... Name of School: .... Address: ...."

This form must be filled and signed by the candidate's teacher. When a candidate has been in regular attendance at a school or academy for any part of the year preceding his Preliminary Examination, his certificate must be signed by the principal of that school or academy.

A Preliminary Certificate will be granted to any candidate who has passed in studies rated in the aggregate at six points.

(*b*) Postponed Examination.

A final candidate, who presents himself in June intending to pass the whole examination in the same year may, under certain conditions, postpone a part of his examination until September. Such a candidate must register in June *not* as a *Preliminary* but as a *Final* candidate.

A Postponing Candidate for admission to the Scientific School will receive no credit for the examination held in June, unless at that examination he passes in studies rated in the aggregate at six points or over.

A final candidate holding a Preliminary Certificate may divide his Final Examination between June and September.

Admission to Advanced Standing.

A candidate may be admitted to advanced Standing either (*a*) by examination, or (*b*) from another Scientific School or College without examination.

(*a*) *By Examination.* — A candidate may be admitted to Advanced Standing if he appear on examination to be versed in the following studies : —

1. The studies required for admission to the First-year class.
2. All the prescribed studies already pursued by the class for which he offers himself, and as many elective studies as he would have pursued if he had entered at the beginning of the First-year.

Examinations for advanced Standing are held only in such courses as are designated in the catalogue as intended primarily for undergraduates; and, among these, in such only as may reasonably be anticipated by examination. No laboratory course, no course in composition or discussion, and no other course in which an examination is obviously an inadequate test may be offered for admission to Advanced Standing.

Candidates for admission to Advanced Standing may divide the examination between June and September; but a candidate who fails in any subject in June will not be examined again in that subject in September.

The Secretary of the School must receive, not later than *September 10*, a written notice specifying the courses in which the candidate wishes to be examined.

(*b*) *Without Examination.* — Graduates of other Scientific Schools or Colleges and students from the higher classes of other Scientific Schools or Colleges may be admitted without examination and assigned to that class in their chosen programme of study in the Lawrence Scientific School (it may be with credits and deficiencies) for which their previous study seems to qualify them. Every case is decided on its merits. Applications are acted on promptly at any time of the year. A candidate for the Lawrence Scientific School under this provision must make a complete written statement of the work on which he bases his application.

Blank forms of application for admission to Advanced Standing without examination may be obtained from the Secretary of the School. This blank should be filled out and returned to the Secretary, accompanied by the catalogue of the School or College which the student has previously attended marked so as to indicate clearly the studies which he offered there for admission and each study which he has successfully completed.

Much importance is attached to the qualify of the work offered. The applicant is expected to furnish official statements of grades in his various college studies, and letters or other evidence showing the opinions his instructors have formed of his character and scholarship.

The Committee on Admission from other Scientific Schools and Colleges of the Lawrence Scientific School will take into account, at their discretion, extra studies pursued by the applicant, or studies pursued by him since graduation, or teaching of advanced grade, or professional study. Early application to the Committee is recommended in order that the student may have time to conform his plans of study to such conditions as the Committee may impose.

Candidates from other Scientific Schools and Colleges may be admitted to the Lawrence Scientific School notwithstanding some deficiencies in their work, on condition that they shall make good these deficiencies before being recommended for the degree.

The degree of Bachelor of Science of Harvard University cannot be conferred on any student who has not completed, as a member of the Lawrence Scientific School, at least one full year's work in this School while registered as a candidate for this degree.

See, also, conditions of candidacy for degrees, page 75.

Admission of Special Students.

Special Students may be admitted to the Lawrence Scientific School under the conditions named below.

When the candidate has *not* been a pupil in any preparatory school for at least one year before the date of his application, and is a person of sufficient maturity and training to qualify him to pursue studies offered in one of the programmes of study in the School, he may be admitted as a Special Student by the Administrative Board. His plan of study must be arranged with reference to the end he seeks to attain, and must be approved by the officer in charge of one of the following programmes of study: Engineering, Mining, Architecture, Landscape Architecture, Forestry, Chemistry, Geology, Biology, Anatomy, Teachers. Except on special vote of the Administrative Board, he will be required, each year, to take work amounting to not less than four full courses.

When the candidate has been a member of a fitting school within one year of the time he applies for admission as a Special Student, his application must be approved by the master of that school. In case he has endeavored to attain regular standing and has failed to pass in a sufficient number of subjects, but is credited with not less than half of the number of "points" required for a clear admission, including English, Algebra, and Geometry, he may, by vote of the Administrative Board, taken in each case in view of the recommendations he brings, be admitted as a Special Student with the expectation that he will gain regular standing in one of the ways indicated below: —

First: By passing the entrance examinations in the omitted subjects.

Second: By obtaining a grade of *C*, or above, in studies directly in continuation of the subjects in which he has failed to pass in the entrance examinations; as, for instance, Advanced French would, if passed with the grade mentioned, remove the entrance "condition" in Elementary French.

Third: By combining the methods above indicated.

Students who, on the recommendation of the masters of fitting schools, have permission to register as Special Students, will be required, except on special vote of the Administrative Board, to attain regular standing within one year after the beginning of the term at which they enter on their course of study.

At least two full courses of the work of each Special Student in the Scientific School must be taken from the regular programme of the Department of study in which he registers.

Special Students are members of the Scientific School from the time of their admission, but are not recognized as in regular standing or as candidates for a degree.

A candidate for admission to the Lawrence Scientific School as a Special Student may obtain a printed form of application from the Secretary of the School. The form must be filled out and returned to the Secretary before the application will be considered by the Administrative Board of the School.

Special Students are subject to all the regulations of the School. A report is sent to their parents or guardians at the end of each year.

The Administrative Board reserves the right to deprive any Special Student of his privileges at any time, if he abuse or fail to use them.

Certain of the subjects required for admission are offered in the courses of instruction in the Summer School of the Faculty of Arts and Sciences. So far as practicable, provision will be made for the instruction in the Summer School, or by private tutors, of those who, during the long vacation, desire to prepare themselves to pass the entrance examinations held in Cambridge in September. This provision is especially designed to meet the needs of candidates who come from schools in which certain of the subjects which may be offered in the entrance examinations are not taught.

A Certificate will be given, if desired, to any Special Student who has faithfully pursued his chosen subjects throughout at least one year and attained satisfactory grades therein.

LIST OF STUDIES IN WHICH ADMISSION EXAMINATIONS ARE HELD

The studies which may be presented in satisfaction of the requirements for admission to the First-Year class in the Lawrence Scientific School must be chosen from the studies named in the following list in accordance with the requirements set forth on the following page.

Elementary

English (*4*)*
Greek (*4*)
Latin (*4*)
German (*2*)
French (*2*)

One of the following two:

History (*2*)
  - Greek and Roman *or*
  - English and American

Civil Government (*1*)
Economics (*1*)
Harmony (*2*)
Algebra (*2*)
Plane Geometry (*2*) *or*
  Geometry (*3*)

Physics (*2*)
Chemistry (*2*)
Physiography (*1*)
Anatomy, Physiology, & Hygiene (*1*)
Botany (*1*)
Zoölogy (*1*)
Drawing,
  - Freehand (*1*)
  - Projections (*1*)

Shopwork,
  - Woodworking (*1*)
  - Blacksmithing (*1*)
  - Chipping, Filing, and Fitting (*1*)
  - Machine-tool Work (*1*)

Advanced

Greek (*2*)
Latin (*2*)
German (*2*)
French (*2*)

History (*2*)
  - *One only of the following four:*
  - Greek and Roman
  - English and American
  - of Europe
  - of a period

Counterpoint (*2*)
Algebra (*1*)
Logarithms and Trigonometry (*1*)
Solid Geometry (*1*)
Physics (*2*)
Meteorology (*1*)
Astronomy (*1*)

Architectural Drawing (*2*)

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* The figure attached to a study indicates the relative weight (termed *points*) which will be given to it in determining the question of the candidate's fitness for admission.

REQUIREMENTS FOR ADMISSION TO THE FIRST-YEAR CLASS.

Every candidate for admission to regular standing in the First-Year class of the Lawrence Scientific School will be required to offer : —

English	4		*Group A*
*Elementary German	2		
*Elementary French	2		
Elementary History	2		
Elementary Algebra	2		
†Plane Geometry	2		
Solid Geometry	1		
He will be required to offer, also, either : —			
Elementary Physics, *or*	2		
Elementary Chemistry	2		
or any two of the following studies : —			
Physiography	1	2	
Anatomy, Physiology, and Hygiene	1	17	
Zoölogy	1		
Botany	1		
Astronomy	1		

In addition to the prescribed studies of Group *A*, aggregating 17 points, the candidate, in order to be admitted without conditions, is required to pass in other studies selected from the list given on the preceding page, aggregating 9 points, making a total of 26 points.

A candidate may be admitted in spite of some deficiencies; but no candidate so admitted will be advanced to the Third-Year class until he has made good such deficiencies to the satisfaction of the Faculty. The exact number of deficiencies with which a candidate may be admitted cannot be named in advance, since each case is considered on its merits.

Some of the courses ordinarily pursued by the student during his first or second year in the Scientific School will, if satisfactorily passed, count also in making up deficiencies in entrance requirements. Such courses are Advanced German, Advanced French, Advanced Algebra, Trigonometry,

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* Advanced German may be offered in place of Elementary French, or Advanced French in place of Elementary German; but when thus displaced the elementary language will become a prescribed study for the first academic year.

† The requirement in Geometry may be satisfied by passing either in Plane Geometry (*2*) and Solid Geometry (*1*), or in Geometry (*3*).

Astronomy, Shopwork, Advanced Physics, Chemistry, Physiography, Meteorology, Botany, Zoölogy, Hygiene, Drawing (Mechanical, Freehand, and Architectural), Government, and Economics.

The admission studies noted below, if passed at entrance, will anticipate prescribed courses in one or more of the Four-Year Programmes in the Scientific School, as well as satisfy admission requirements: —

Advanced German (German 1*c*), Advanced French (French 1*c*), Advanced Algebra (Engineering 1*a*), Logarithms and Trigonometry (Engineering 1*b*), Elementary Physics (Physics *B*), Advanced Physics (Physics *C*), Physiography (Geology *A*), Meteorology (Geology *B*), Projection Drawing (Engineering 3*a* in part), Architectural Drawing (Architecture 2*a* in part), Shopwork (Engineering 10*a*, 10*b*, and 10*e*), and Anatomy (first half of Hygiene 1).

STUDIES IN WHICH EXAMINATIONS ARE HELD.

1. English.

A candidate for admission to Harvard College or the Lawrence Scientific School may take either of the examinations, (a) and (b), described below. If he passes (b) he is exempt from the prescribed English of the Freshman year (English A); but if he passes it with Grade D he is required to take before the end of his second year a half-course in English Composition in addition to his regular elective courses: furthermore, on the evidence of his examination book he may be credited with an ungraded mark of "pass," but required to take the prescribed English of the Freshman year.

(*a*) *Elementary English.*

The examination will consist of two parts, which, however, cannot be taken separately: —

I. The candidate will be required to write a paragraph or two on each of several topics chosen by him from a considerable number — perhaps ten or fifteen — set before him on the examination paper.

In 1904 and 1905 the topics will be drawn from the following works: —

Shakspere's The Merchant of Venice and Julius Caesar; The Sir Roger de Coverley Papers in the Spectator; Goldsmith's The Vicar of Wakefield; Coleridge's The Ancient Mariner; Scott's Ivanhoe; Carlyle's Essay on Burns; Tennyson's Princess; Lowell's Vision of Sir Launfal; George Eliot's Silas Marner.

In 1906, 1907, and 1908 the topics will be drawn from the following works: —

Shakspere's Macbeth and The Merchant of Venice; The Sir Roger de Coverley Papers in the Spectator; Irving's Life of Goldsmith; Coleridge's The Ancient Mariner; Scott's Ivanhoe and The Lady of the Lake; Tennyson's Gareth and Lynette, Lancelot and Elaine, and The Passing of Arthur; Lowell's The Vision of Sir Launfal; George Eliot's Silas Marner.

The candidate is expected to read intelligently *all* the books prescribed. He should read them as he reads other books; he is expected, not to know them minutely, but to have freshly in mind their most important parts. In every case the examiner will regard knowledge of the book as less important than ability to write English.

As additional evidence of preparation, the candidate may present an exercise-book, properly certified by his instructor, containing compositions or other written work.

II. A certain number of books will be prescribed for careful study. This part of the examination will be upon subject-matter, literary form, and logical structure, and will also test the candidate's ability to express his knowledge with clearness and accuracy. The books prescribed for this part of the examination in 1904 and 1905 are: —

Shakspere's Macbeth; Milton's Lycidas, Comus, L'Allegro, and Il Penseroso; Burke's Speech on Conciliation with America; Macaulay's Essays on Milton and Addison.

The books prescribed for this part of the examination in 1906, 1907, and 1908 are: —

Shakspere's Julius Caesar; Milton's L'Allegro, Il Penseroso, Comus, and Lycidas; Burke's Speech on Conciliation with America; Macaulay's Essay on Milton, and Life of Johnson.

No candidate will be accepted in English whose work is seriously defective in point of spelling, punctuation, grammar, or division into paragraphs.

In connection with the reading and study of the prescribed books, parallel or subsidiary reading should be encouraged, and a considerable amount of English poetry should be committed to memory. The essentials of English grammar should not be neglected in preparatory study.

The English written by a candidate in any of his examination-books may be regarded as part of his examination in English, in case the evidence afforded by the examination book in English is insufficient.

(*b*) *English.*

The examination will consist of questions in Rhetoric,* questions in Literary History from the time of Shakspere, and compositions based on the following works:

Palgrave:
  Golden Treasury (First Series)

Shakspere:
  Julius Caesar
  The Merchant of Venice
  Macbeth
  Twelfth Night *or* As You Like It
  King Lear *or* Hamlet

Milton:
  L'Allegro
  Il Penseroso
  Comus

Bunyan:
  The Pilgrim's Progress, *or*
Defoe:
  Robinson Crusoe

Dryden:
  Alexander's Feast
  To the Memory of Mr. Oldham
  Upon the Death of the Earl of Dundee

Swift:
  The Voyage to Lilliput

Addison and Steele:
  The Sir Roger de Coverley Papers

Pope:
  Epistle to Arbuthnot

Goldsmith:
  The Vicar of Wakefield
  The Deserted Village

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* A. S. Hill's Principles of Rhetoric is used for the corresponding study in Harvard College, and is recommended for use in preparation for this examination.

Scott:
- The Lady of the Lake
- Ivanhoe
- Quentin Durward

Macaulay:
- Life of Johnson
- Lays of Ancient Rome

Byron:
- Mazeppa
- The Prisoner of Chillon

Irving:
- The Legend of Sleepy Hollow
- Rip Van Winkle
- Tales of a Traveller

Thackeray:
- Henry Esmond

Dickens:
- A Tale of Two Cities *or* David Copperfield

Browning: Selections; for example,
- Cavalier Tunes
- The Lost Leader
- How They Brought the Good News from Ghent to Aix
- Evelyn Hope
- Home Thoughts, from Abroad
- Home Thoughts, from the Sea
- Incident of the French Camp
- The Boy and the Angel
- One Word More
- Hervé Riel
- Pheidippides

Tennyson: Selections; for example,
- Enid
- Elaine
- The Passing of Arthur
- The Lady of Shalott
- The Lotus Eaters
- Ulysses
- Tithonus
- The Revenge

Franklin:
- Autobiography

Hawthorne:
- The House of the Seven Gables

Longfellow:
- Tales of a Wayside Inn

Lowell:
- The Vision of Sir Launfal

The candidate is expected to read all the books prescribed.* He should read them as he reads other books, — not trying to remember them in detail, but regarding each work as a whole and giving it such appreciation as shall enable him to write about it intelligently. In every case the examiner will regard knowledge of the books as less important than ability to write English; if the examination book in English affords insufficient evidence, he will examine the written work of the candidate in other subjects.

No candidate will be accepted in English whose work is seriously faulty in spelling, grammar, punctuation, or division into paragraphs.

Preparation for the examination should occupy at least three school hours, or periods, a week for four years. Throughout the course frequent short compositions should be required as well as occasional long ones. Topics should be chosen by the pupil himself whenever that is possible; and the topics assigned by the instructor should be within the range of the pupil's knowledge and sympathies, and should be such as to awaken interest and stimulate intelligence. Criticism should be constant and thorough; it should take account of merits as well as of faults, and should never interfere with the honest expression of opinion or with the free play of individuality in thought and expression. Mechanical methods of every kind should be avoided; and attention should be fixed on principles rather than rules.

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* In connection with the prescribed books, parallel or subsidiary reading should be encouraged, and a considerable amount of English poetry committed to memory.

As to the right way of studying Rhetoric, attention is called to the following extract from the Report of the Vassar Conference: *

"Though it is clear that the power to write a language can be obtained only by unremitting practice, yet, in the opinion of the Conference, such practice may properly be accompanied and illustrated by a course in elementary rhetoric. This course should include not only the principles of clearness, force, and good taste, but the principles of the arrangement of clauses in the sentence and of sentences in the paragraph. The teacher should bear in mind that any body of written English, of whatever length, is an organic unit, with principles that apply as well to the arrangement of the minor elements as to the grouping of the larger divisions of essay or book. Especial care should be taken that rhetoric is not studied by itself or for its own sake. Its connection with the pupil's actual written or spoken exercises should be kept constantly in view."

2, 3. Greek.

2. *Elementary Greek.*

The examination will be adapted to the proficiency of those who have studied Greek in a systematic course of five exercises a week, extending through at least *two* school years. The two parts of the examination cannot be taken separately: —

(*a*) The translation at sight of simple Attic prose. (The passages set for translation must be rendered into simple and idiomatic English.)

(*b*) A thorough examination on a prescribed portion of Xenophon (about thirty pages †), directed to testing the candidate's mastery of the ordinary forms, constructions, and idioms of the language; the test to consist, in part, of writing simple Attic prose, involving the use of such words, constructions, and idioms only as occur in the portion of Xenophon prescribed.

The portion of Xenophon prescribed for this examination for 1904 and 1905 is the second book of the Anabasis. For 1906 and thereafter the selection will be the first book of the Anabasis, chapters i–viii. Two years' notice will be given of any further change in the selection.

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* Report of the Committee of Ten, page 95, section 8.

† The pages of the more recent Teubner text editions are taken as a standard in this statement.

3. *Advanced Greek.*

The examination will be adapted to the proficiency of those who have studied Greek in a systematic course of five exercises a week, extending through at least *three* school years. The second part of the examination (Greek Composition) is optional, and may be omitted without loss of credit: —

(*a*) The translation at sight of Attic prose and of Homer, with questions designed to test the candidate's understanding of the passages set, and questions on ordinary forms, constructions, and idioms, and on prosody. In 1906 and thereafter there will also be questions on the Homeric poems and Homeric life. (The passages set for translation must be rendered into simple and idiomatic English.)

(*b*) The translation into Attic prose of a short passage of connected English narrative. (The passage set for translation will be based on some portion of the Greek prose works usually read in preparation for College, and will be limited to the subject-matter of those works.)

The estimate of the periods of study necessary to prepare for the elementary and advanced examinations in Greek is based on the assumption that the candidate has begun the study of Latin at least a year earlier, and has continued it along with his Greek course; otherwise the periods specified would not be sufficient.

In preparation for the elementary examination in Greek, candidates should read from 130 to 170 pages * of Attic prose. For the advanced examination candidates should read from 30 to 50 pages more of Attic prose, and from 3000 to 5000 verses of Homer. The reading of Homer may be advantageously begun with a thorough study of Iliad, Books I and II (to the catalogue of ships).

The pupil should be constantly guided in proper methods of reading, and trained to read the Greek intelligently, as Greek, before undertaking to render it into idiomatic English. There should be constant practice in reading aloud, with due expression, and in hearing the language read. In connection with the reading, to ensure thoroughness and accuracy in the pupil's understanding of the language, the study of grammar, with some practice in writing Greek, should be maintained throughout the course. There should also be frequent written translations into idiomatic English.

To prepare for the examination in Greek Composition, pupils should be trained, from an early stage of the preparatory course, to render into Greek, not merely detached sentences, illustrative of constructions, but also passages of connected narrative or description, prepared by the teacher on the basis of the prose authors read.

4, 5. Latin.

[*Only plan for 1904; optional with new plan for 1905.*]

4. *Elementary Latin.*

The examination will be adapted to the proficiency of those who have studied Latin in a systematic course of five lessons a week, extending through at least *three* school years. The two parts of the examination cannot be taken separately: —

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* The pages of the more recent Teubner text editions are taken as a standard in this statement.

(*a*) The translation at sight of simple Latin prose and verse. (The passages set for translation must be rendered into simple and idiomatic English.)

(*b*) A thorough examination on a prescribed portion of Cicero's speeches (about thirty pages*), directed to testing the candidate's mastery of the ordinary forms, constructions, and idioms of the language; the test to consist, in part, of writing simple Latin prose, involving the use of such words, constructions, and idioms only as occur in the speeches prescribed.

The portion of Cicero prescribed for this examination is the second, third, and fourth speeches against Catiline. Two years' notice will be given of any change in the selection.

5. *Advanced Latin.*

The examination will be adapted to the proficiency of those who have studied Latin in a systematic course of five lessons a week, extending through at least *four* school years. The two parts of the examination cannot be taken separately: —

(*a*) The translation at sight of Latin prose and verse, with questions designed to test the candidate's understanding of the passages set, and questions on ordinary forms, constructions, and idioms, and on prosody. (The passages set for translation must be rendered into simple and idiomatic English.)

(*b*) The translation into Latin prose of a short passage of connected English narrative. (The passage set for translation will be based on some portion of the Latin prose works usually read in preparation for College, and will be limited to the subject-matter of those works.)

The estimate of the periods of study necessary to prepare for the examinations in Latin is made with reference to schools which have a four years' course. Schools which have a five years' course may more advantageously provide for beginning the study of Latin in the first year, with some diminution, if necessary, of the time devoted to it in the last years of the course.

The course of reading pursued in preparation for the examinations in Latin should include: —

(*a*) Easy reading, included in or following a suitable introductory book ('Latin Lessons'), amounting to from 30 to 40 pages;*

(*b*) Nepos (Lives) and Caesar (Gallic War), 90 to 120 pages;

(*c*) Cicero, 90 to 120 pages, including the four speeches against Catiline and the speech on the Manilian Law, with additional speeches selected by the teacher;

(*d*) Virgil and Ovid, 6000 to 10,000 verses, including the first six books of the Aeneid.

Preparation for the elementary examination alone should include (*a*) and (*b*), the four speeches against Catiline, and from 2000 to 3000 verses of Virgil, or of Ovid and Virgil.

The pupil should be constantly guided in proper methods of reading, and trained to read the Latin intelligently, as Latin, before undertaking to render it into idiomatic English. There should be constant practice in reading aloud, with due expression, and in hearing the language read. In connection with the reading, to ensure thoroughness and accuracy in the pupil's understanding of the language, the study of grammar, with some practice in writing Latin, should be maintained throughout the course. There should also be frequent written translations into idiomatic English.

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* See foot-note, p. 53.

To prepare for the examination in Latin Composition, pupils should be trained, from an early stage of the preparatory course, to render into Latin not merely detached sentences, illustrative of constructions, but also passages of connected narrative or description, prepared by the teacher on the basis of the prose authors read.

4, 5. Latin.

[*Optional with old plan for 1905; only plan for 1906 and thereafter.*]

4. *Elementary Latin.*

The examination will be adapted to the proficiency of those who have studied Latin in a systematic course of five lessons a week, extending through at least *three* school years. The passages set for translation must be rendered into simple and idiomatic English. The three parts of the examination cannot be taken separately: —

(*a*) The translation at sight of simple Latin prose.

(*b*) An examination (which may include translation) on the first four books of Virgil's Aeneid, or on selected myths from Ovid's Metamorphoses, with questions on the subject-matter and on literary and historical allusions. Two years' notice will be given of any change in these alternative requirements.

(*c*) An examination directed to testing the candidate's mastery of the ordinary forms, constructions, and idioms of the language; the test to consist, in part, of writing simple Latin prose.

5. *Advanced Latin.*

The examination will be adapted to the proficiency of those who have studied Latin in a systematic course of five lessons a week, extending through at least *four* school years. The passages set for translation must be rendered into simple and idiomatic English. The three parts of the examination cannot be taken separately: —

(*a*) The translation at sight of Latin prose and verse, with questions on ordinary forms, constructions, and idioms, and on prosody.

(*b*) An examination (which may include translation) on Cicero's four speeches against Catiline and the Defence of Archias; with questions on the subject-matter, the life of Cicero, and his position in literature.

(*c*) The translation into Latin prose of a short passage of connected English narrative. (The passage set for translation will be based on some portion of the Latin prose works usually read in preparation for College, and will be limited to the subject-matter of those works.)

The estimate of the periods of study necessary to prepare for the examinations in Latin is made with reference to schools which have a four years' course. Schools which have a five years' course may more advantageously provide for beginning the study of Latin in the first year, with some diminution, if necessary, of the time devoted to it in the last years of the course.

The course of reading pursued in preparation for the examinations in Latin should include:—

(*a*) Easy reading, included in or following a suitable introductory book ('Latin Lessons'), amounting to from 30 to 40 pages;*

(*b*) Nepos (Lives) and Caesar (Gallic War), 90 to 120 pages;

(*c*) Cicero, 90 to 120 pages, including the four speeches against Catiline and the Defence of Archias, with additional speeches selected by the teacher;

(*d*) Virgil and Ovid, 6,000 to 10,000 verses, including the first six books of the Aeneid.

Preparation for the elementary examination alone should include (*a*) and (*b*), about 40 pages of Cicero, and either the first four books of Virgil's Aeneid, or the following myths from Ovid's Metamorphoses: Deucalion, Daphne, Phaethon, Cadmus, Pyramus, Andromeda, Proserpina, Niobe, Medea, Meleager, Philemon, Atalanta, Midas, Alcyone, Galatea.

The pupil should be constantly guided in proper methods of reading, and trained to read the Latin intelligently, as Latin, before undertaking to render it into idiomatic English. There should be constant practice in reading aloud, with due expression, and in hearing the language read. In connection with the reading, to ensure thoroughness and accuracy in the pupil's understanding of the language, the study of grammar, with some practice in writing Latin, should be maintained throughout the course. There should also be frequent written translations into idiomatic English.

To prepare for the advanced examination in Latin Composition, pupils should be trained, from an early stage of the preparatory course, to render into Latin not merely detached sentences, illustrative of constructions, but also passages of connected narrative or description, prepared by the teacher on the basis of the prose authors read.

6, 7. German.

6. *Elementary German.*

(*a*) The translation at sight of simple German prose. (The passages set for translation must be rendered into simple and idiomatic English.)

(*b*) The translation into German of simple English sentences, or of easy connected prose, to test the candidate's familiarity with elementary grammar.

The passages set for translation into English will be suited to the proficiency of candidates who have read not less than two hundred pages of easy German (including reading at sight in class).

Grammar should be studied concurrently with the reading as an indispensable means of ensuring thoroughness and accuracy in the understanding of the language. The requirement in elementary grammar includes the conjugation of the weak and the more usual strong verbs; the declension of articles, adjectives, pronouns, and such nouns as are readily classified; the commoner prepositions; the simpler uses of the modal auxiliaries; the elements of syntax, especially the rules governing the order of words.

Pronunciation should be carefully taught, and the pupils should have frequent opportunities to hear German spoken or read aloud. The writing of German from dictation is recommended as a useful exercise.

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* See foot-note, p. 53.

7. *Advanced German.*

(*a*) The translation at sight of ordinary German. (The passages set for translation must be rendered into simple and idiomatic English.)

(*b*) The translation into German of a connected passage of English prose, to test the candidate's familiarity with grammar. Proficiency in grammar may also be tested by direct questions.

The passages set for translation into English will be suited to the proficiency of those who have read, in addition to the amount specified under Elementary German, not less than five hundred pages of classical and contemporary prose and verse. It is recommended that the reading be selected from such works as the following: Riehl, *Culturgeschichtliche Novellen;* Freytag, *Bilder aus der deutschen Vergangenheit*, *Die Journalisten;* Kohlrausch, *Das Jahr 1813;* Schiller, *Der dreissigjährige Krieg*, *Wilhelm Tell*, *Maria Stuart*, *Die Jungfrau von Orleans;* Goethe, *Hermann und Dorothea*, *Egmont*, *Iphigenie;* Lessing, *Minna von Barnhelm.* About one half of the amount read should be Nineteenth Century prose.

In the translation into German, candidates will be expected to show a thorough knowledge of accidence, the elements of word-formation, the principal uses of prepositions and conjunctions, and the essentials of syntax, especially the uses of the modal auxiliaries, and of the subjunctive and infinitive modes.

It is recommended that the candidate be trained to follow a recitation conducted in German and to answer in that language questions asked by the instructor.

8, 9. French.

8. *Elementary French.*

(*a*) The translation at sight of ordinary Nineteenth Century prose. (The passages set for translation must be rendered into simple and idiomatic English.)

(*b*) The translation into French of simple English sentences or of easy connected prose, to test the candidate's familiarity with elementary grammar. Proficiency in grammar may also be tested by direct questions, based on the passages set for translation under (*a*).

The passages set for translation into English will be suited to the proficiency of candidates who have read not less than four hundred pages (including reading at sight in class) from the works of at least three different authors. It is desirable that a portion of the reading should be from works other than works of fiction.

Grammar should be studied concurrently with the reading as an indispensable means of ensuring thoroughness and accuracy in the understanding of the language. The requirement in elementary grammar includes the conjugations of regular verbs, of the more frequent irregular verbs, such as *aller*, *envoyer*, *tenir*, *pouvoir*, *voir*, *vouloir*, *dire*, *savoir*, *faire*, and those belonging to the classes represented by *ouvrir*, *dormir*, *connaître*, *conduire*, and *craindre;* the forms and positions of personal pronouns and of possessive, demonstrative, and interrogative adjectives; the inflection of nouns and adjectives for gender and number, except rare cases; the uses of articles, and the partitive constructions.

Pronunciation should be carefully taught, and pupils should have frequent opportunities to hear French spoken or read aloud. The writing of French from dictation is recommended as a useful exercise.

9. *Advanced French.*

(*a*) The translation at sight of standard French. (The passages set **for** translation must be rendered into simple and idiomatic English.)

(*b*) The translation into French of a connected passage of English prose, to test the candidate's familiarity with grammar. Proficiency in grammar may also be tested by direct questions.

The passages set for translation into English will be suited to the proficiency of candidates who have read, in addition to the amount specified under Elementary French, not less than six hundred pages of prose and verse from the writings of at least four standard authors. A considerable part of the amount read should be carefully translated into idiomatic English.

Candidates will be expected to show a thorough knowledge of accidence and familiarity with the essentials of French syntax, especially the uses of tenses, modes, prepositions, and conjunctions.

It is recommended that the candidate be trained to follow a recitation conducted in French and to answer in that language questions asked by the instructor.

10, 11. History (including Historical Geography).

10. *Elementary History.*

Either of the two following groups, each including two fields of historical study: —

1. *Greek and Roman History.* — (*a*) Greek History to the death of Alexander, with due reference to Greek life, literature, and art. (*b*) Roman History to the accession of Commodus, with due reference to literature and government.

2. *English and American History.* — (*a*) English History, with due reference to social and political development. (*b*) American History, with the elements of Civil Government.

For preparation in each of the two historical fields presented, a course of study equivalent to at least three lessons a week for one year will be necessary.

The candidate will be expected to show on examination such general knowledge of each field as may be acquired from the study of an accurate text-book of not less than 300 pages, supplemented by suitable parallel readings amounting to not less than 500 pages. The examination will call for comparison of historical characters, periods, and events, and in general for the exercise of judgment as well as of memory. Geographical knowledge will be tested by means of an outline map.

In the judgment of the Department of History it is desirable that Greek and Roman History be offered as a part of the preparation of every candidate.

11. *Advanced History.*

Any one of the four courses of study which follow: —

1. Greek History to the destruction of Corinth and Roman History to the death of Constantine (open to those candidates only who have offered English and American History as an elementary study).

2. English History and American History (open to those candidates only who have offered Greek and Roman History as an elementary study).

3. European History from the Germanic conquests to the beginning of the Seventeenth Century.

4. A year's study of any one of the four historical fields defined under Elementary History and not already offered by the candidate, together with a year's detailed study of a limited period within that field, selected with the approval of the Department of History.*

In every case the candidate will be expected to show on examination such an acquaintance with the whole field as may be gained from the study of good text-books, together with substantial parallel readings, and, further, such a detailed knowledge of some part of the field as may be gained from suitable topical study. A higher standard of acquirement and of power to combine results will be expected than in the elementary requirement.

As further evidence of the candidate's proficiency satisfactory written work, done at school and certified by the teacher, must be submitted at the time of the examination. It must be presented in the form of a note-book (or bound collection of notes), containing not less than 50 written pages on each historical field offered, and must show practice in some of the following exercises: —

(*a*) Notes and digests of the pupil's reading outside of the text-books.

(*b*) Brief written tests requiring the application to new questions of knowledge previously acquired.

(*c*) Parallels between historical characters or periods.

(*d*) Short studies of topics limited in scope, prepared outside of the class-room and illustrated by some reference to contemporary material.

(*e*) Historical maps or charts showing explorations, migrations, conquests, territorial changes, or social conditions.

12, 13. Music.

12. *Harmony.*

The examination will be adapted to the proficiency of those who have studied Harmony in a systematic course of three lessons a week through one school year. Proficiency in pianoforte playing, and the ability to read chorals and moderately easy piano pieces at sight will be required. The work should consist partly of exercises written on figured basses in which all the triads and seventh-chords are to be employed progressively, and partly of the harmonization of simple melodies. Exercises must be written in a clear and well formed notation. The course will embrace: —

1. Notation; Clefs; Signatures; Diatonic and Chromatic Intervals and their inversions; Consonance and Dissonance; Major and Minor diatonic scales; Chromatic Scale; Natural Harmonic Series.
2. Triads of the Major and Minor modes.
3. Rules of chord-connection; Range of voices; Open and Close harmony; Tonality.
4. Inversions of Triads; Principles of doubling voices in chords, especially in successive Sixth-chords.
5. Chords of the Dominant Seventh, Dominant Ninth, and Diminished Seventh; Preparation and Resolution.

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* For example, the Spartan and Theban supremacies, the period of the Punic wars, the Stuart Period, the transition from the American colonial to the federal system. The examination in the second part of 4 will be specially adapted to the particular period selected and will be held in Cambridge only.

6. Secondary Seventh-chords; Altered Chords; Augmented Chords.
7. Suspensions.
8. Passing and Changing notes; Pedal Point.
9. Principles of key-relationship; Simple modulation.

Shepherd's *Harmony* is recommended as a text-book.

13. *Counterpoint.*

The examination will be adapted to the proficiency of those who have studied Counterpoint in a systematic course of three lessons a week through one school year, and presupposes training in pianoforte playing. As counterpoint applies the principles of harmony to the melodious treatment of the several voice-parts in combination, and as the art of musical composition begins properly with this study, the work should consist principally of written exercises on given themes, in the following order: —

Chorals and melodies harmonized, with a free use of passing notes; the several orders of Counterpoint in two, three, and four voices, with and without *cantus firmus*; Double Counterpoint; Free Imitative Counterpoint; Analysis of the Two-part Inventions of Sebastian Bach; Simple forms of free composition, Organ Preludes, Two-part Inventions, and Part Songs.

Students should use as models simple organ compositions and part-songs of modern composers. For the exercises in counterpoint the alto and tenor clefs should be used.

14–17. Mathematics.

A thorough practical acquaintance with ordinary Arithmetic is assumed as underlying all preparation in Mathematics. Knowledge of the fundamental principles of Arithmetic and careful training in accurate computation with whole numbers and with vulgar and decimal fractions form an essential part of early school work. But the pupil's time should not be wasted in the solution by arithmetic of puzzling problems which properly belong to algebra, or in complicated and useless reductions, or in the details of commercial arithmetic. It is desirable that some familiarity with algebraic expressions and symbols, including the methods of solving simple equations, be acquired in connection with the course in Arithmetic.

Elementary Mathematics.

14. *Elementary Algebra.*—Algebra, through Quadratic Equations.

The requirement in Algebra includes the following subjects: factors, common divisors and multiples, fractions, ratios and proportions; negative quantities and the interpretation of negative results; the doctrine of exponents; radicals and equations involving radicals; the binomial theorem for positive integral powers of the binomial, and the extraction of roots; arithmetical and geometrical progressions; putting questions into equations and the reduction of equations; the ordinary methods of elimination and the solution of both numerical and literal equations of the first and second degrees with one or more unknown quantities and of problems leading to such equations.

The student should cover carefully the whole ground here specified, and should acquire a thorough understanding not only of the practice, but of the reasons involved in the elementary algebraic rules; for example, in the rules of multiplication, of signs, and of exponents, in the rules for fractions, and in those relating to the reduction and solution of equations. He should train himself to practical skill by the solution of a large number of examples, and should learn to do his work with reasonable quickness, as well as with confidence, accuracy, and clearness. The solution of fairly complicated literal quadratics, the various methods of elimination for equations of the first two degrees, the putting of problems in a neat manner into equations, and the working of the various algebraic operations both for integral and fractional expressions may be mentioned as important subjects of attention. The student should be taught to arrange his work in a clear, orderly, and compact fashion.

The time supposed to be devoted to the systematic study of the requirement in Algebra is the equivalent of a course of three lessons a week through two school years.

15. *Geometry.* — Plane and Solid Geometry, including problems in mensuration of plane and solid figures, and original propositions in Plane Geometry.

Geometric education should begin in the kindergarten or primary school, where the child should acquire familiarity through the senses with simple geometric forms, by inspecting, drawing, modelling, and measuring them, and noting their more obvious relations. This study should be followed, in the grammar school, by systematic instruction in Concrete (or Observational) Geometry, of which geometric drawing should form a part. Such instruction should include the main facts of Plane and Solid Geometry, treated as matters of observation, and not as exercises in logical deduction, without however necessarily excluding the beginnings of deductive proof as soon as the pupil is ready for them. Concrete Geometry is believed to have important educational value, and to prepare an excellent foundation for the later study of Formal Geometry. It belongs, however, to the earlier stages of school work, and should not be postponed until the time that belongs to direct preparation for college or the scientific school.

In teaching Formal Geometry, stress should be laid from the outset on accuracy of statement and elegance of form, as well as on clear and strict reasoning. As soon as the pupil has begun to acquire the art of rigorous demonstration, his work should cease to be merely receptive, he should be trained to devise constructions and demonstrations for himself, and this training should be carried through the whole of the work in Plane Geometry. Teachers are advised, in their selection of a text-book, to choose one having a clear tendency to call out the pupil's own powers of thought, prevent the formation of mechanical habits of study, and encourage the concentration of mind which it is a part of the discipline of mathematical study to foster. The subject of Geometry, not a particular treatise, is what the pupil should be set to learn; and its simpler methods and conceptions should be made a part of his habitual and instinctive thought. Lastly, the pupil should be stimulated to good work by interest in the study felt and exhibited by the teacher.

The requirement in Geometry embraces the following topics: the general properties of plane rectilinear figures; the circle and the measure of angles; similar polygons; areas; regular polygons, and the measure of the circle; the relations of planes and lines in space; the properties and measure of prisms, pyramids, cylinders, and cones; the sphere and the spherical triangle. The propositions required under these several heads are those only which are contained in the older treatises, and which are recognized as constituting the Elements of Geometry. The examination does not include the additions introduced into some recent text-books, although most of those additions are in themselves valuable for the student who has time and taste for extra study in this field. A syllabus of the required propositions has been prepared. [*This Syllabus may be obtained, price 10 cents, at the Publication Office, 2 University Hall, Cambridge.*]

The examination in Geometry also includes original propositions in Plane Geometry, based on the propositions named in the Syllabus, and problems in mensuration in both Plane and Solid Geometry; but excellence in bookwork and in exercises immediately illustrating bookwork will be allowed to offset in part any lack of skill in original work.

The time which it is recommended to assign to the systematic study of the requirement in Formal Geometry is the equivalent of a course of five lessons a week for one school year; but it is believed to be advisable to extend this allowance of time over two years.

15a. *Plane Geometry.*

The requirement in Plane Geometry is stated on pages 1–14 of the Syllabus mentioned above.

Advanced Mathematics.

15b. *Solid Geometry.*

Chauvenet's *Geometry*, Revised and Abridged (Philadelphia: J. B. Lippincott & Co.), Books VI, VII, VIII, and IX, will serve to indicate the nature and amount of the requirement in Solid Geometry.

16. *Logarithms and Trigonometry.* — The theory of logarithms and the use of logarithmic tables. — Plane trigonometry. — The solution of the right spherical triangle. — Applications to simple problems.

No technical knowledge of the subjects of surveying and navigation, such, for instance, as the methods of parallel or middle latitude sailing, will be required, but such terms as latitude, longitude, angle of elevation or depression, bearing, etc., should be understood. At the examination, candidates are furnished with four-place tables belonging to the University, and are not allowed to use their own tables. The tables provided are distributed before the hour of examination, so that candidates may have at least an hour for becoming acquainted with their arrangement and use. Teachers who wish a still earlier opportunity of seeing these tables should write to the Secretary of the Faculty.

17. *Advanced Algebra.*

The requirement in Advanced Algebra includes the following subjects:

(*a*) Simultaneous quadratics and equations solved like quadratics; properties of quadratic equations; addition, subtraction, multiplication and division of complex quantities; inequalities; variations; arithmetical and geometrical progressions; mathematical induction; simple problems in choice and chance; continued fractions; scales of notation.

(*b*) Determinants, not including the multiplication theorem; simple applications of determinants to linear equations; the solution of numerical equations of higher degree, and so much of the theory of equations (not including multiple roots or Sturm's theorem) as is necessary for this purpose.

The topics included under (*a*) may be treated briefly. About half the time devoted to the requirements should be spent on the topics included under (*b*).

18–24. Physical Science.*

Elementary Physical Science.

18. *Elementary Physics.* — A course of study dealing with the leading elementary facts and principles of physics, with quantitative laboratory work by the pupil.

The instruction given in this course should include qualitative lecture-room experiments, and should direct especial attention to the illustrations and applications of physical laws to be found in every-day life. The candidate is required to pass a written examination, the main object of which will be to determine how much he has profited by such instruction. This examination may include numerical problems. It will contain more questions than any one candidate is expected to answer, in order to make allowance for a considerable diversity of instruction in different schools.

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* For rules relating to the time of handing in note-books and to candidates examined in June in places where no laboratory examination is provided, see page 72.

The pupil's laboratory work should give practice in the observation and explanation of physical phenomena, some familiarity with methods of measurement, and some training of the hand and the eye in the direction of precision and skill. It should also be regarded as a means of fixing in the mind of the pupil a considerable variety of facts and principles. The candidate is required to pass a laboratory examination, the main object of which will be to determine how much he has profited by such a laboratory course.

The candidate must name as the basis for his laboratory examination at least thirty-five exercises selected from a list of about sixty, described in a publication issued by the University under the title, "Descriptive List of Elementary Exercises in Physics." [*This list may be obtained, price 40 cents, at the Publication Office, 2 University Hall, Cambridge.*] In this list the divisions are mechanics (including hydrostatics), light, heat, sound, and electricity (with magnetism). At least ten of the exercises selected must be in mechanics. Any one of the four other divisions may be omitted altogether, but each of the three remaining divisions must be represented by at least three exercises.

The candidate is required to present a note-book in which he has recorded the steps and the results of his laboratory exercises, and this note-book must bear the endorsement of his teacher, certifying that the notes are a true record of the pupil's work. It should contain an index of the exercises which it describes. These exercises need not be the same as those upon which the candidate presents himself for the laboratory examination, but should be equivalent to them in amount and grade of quantitative work.

The note-book is required as proof that the candidate has formed the habit of keeping a full and intelligible record of laboratory work through an extended course of experiments, and that his work has been of such a character as to raise a presumption in favor of his preparation for the examination. But much greater weight will be given to the laboratory examination than to the note-book in determining the candidate's attainments in physics. Experience has shown that pupils can make the original record of their observations entirely presentable, so that copying will be unnecessary, and they should in general be required to do so.

This course, if taken in the last year of the candidate's preparation, is expected to occupy in laboratory work, recitations, and lectures, five of the ordinary school periods, about fifty minutes in length, per week for the whole year. With few exceptions exercises like those in the Descriptive List already mentioned can be performed in a single school period, but for satisfactory results it will often be necessary to repeat an exercise. Two periods per week for the year should be sufficient for the laboratory work proper. If the course is begun much earlier than the last year of the candidate's preparation, as it well may be, it will require more time.

19. *Chemistry.* * — A course of at least sixty experiments, performed at school by the pupil and accompanied with systematic instruction in principles and their applications, in accordance with directions given in a pamphlet entitled "An Outline of Requirements in Chemistry," issued by the University for *the use of teachers only.*

The candidate is required to pass both a written and a laboratory examination. The written examination will test his acquaintance with the facts and principles of Chemistry. The laboratory examination will test both his skill in performing experiments and his grasp of the principles involved in them. The candidate is further required to present the original note-book in which he recorded the steps and results of the experiments which he performed at school, and this note-book must bear the endorsement of his teacher, certifying that the notes are a true record of the pupil's work. It should contain an index of the exercises which it describes.

The note-book is required as proof that the candidate has formed the habit of keeping a full and intelligible record of laboratory work through an extended course of experiments, and that his work has been of such a character as to raise a presumption in favor of his preparation for the examination. But much greater weight will be given to the laboratory examination than to the note-book in determining the candidate's attainments in Chemistry.

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* The course will be mainly an experimental course in theoretical chemistry, but there will be experiments covering all branches of pure chemistry.

20. *Physiography.* — A course of study equivalent to that described in a pamphlet entitled "An Outline of Requirements in Physiography," issued by the University.

For the form of examination see note under Astronomy, below.

21. *Anatomy, Physiology, and Hygiene.* * — A course of study and laboratory work equivalent to that described in a pamphlet entitled "An Outline of Requirements in Anatomy, Physiology, and Hygiene," issued by the University.

The candidate will be required to pass both a written and a laboratory examination. The written examination will test the range and thoroughness of his knowledge of the elements of Anatomy, Physiology, and Hygiene. The laboratory examination will test (*a*) his ability to perform the experiments described in the Outline of Requirements, and (*b*) his knowledge of the first aids to be rendered to the injured.

At the time of the laboratory examination the candidate must present the original note-book containing (with dates) the notes and drawings he has made in the course of his laboratory work, and bearing the endorsement of his teacher, certifying that the book is a true record of the pupil's own observations and experiments. An index of subjects should be appended.

Advanced Physical Science.

22. *Advanced Physics.*†

The University does not prescribe the experiments to be performed by those offering this subject for admission. The work should, however, be of advanced grade, almost wholly quantitative, and conducted with apparatus, not necessarily elaborate, yet capable, if carefully handled, of yielding results of such accuracy as to warrant the consideration of somewhat minute error. For example, the balance used in weighing should be so delicate as to justify corrections for the buoyancy of the air on the weights and on the body weighed, and, in the determination of specific gravity, for the temperature of the water. The results should be discussed with reference to their precision and to the number of significant figures. There should be about sixty experiments well distributed through the range of general physics. If the student has devoted a considerable amount of time in the elementary course to experiments in heat, that division of physics may be here omitted. The laboratory work can be performed properly only in periods of considerable length, two to four hours, for example.

Instruction by lectures or text-books and work in problems should be a part of the course.

The candidate will be required to pass both a laboratory and a written examination. He should so thoroughly understand the work which he has performed as not to be confused in the laboratory examination by unfamiliar forms of apparatus.

The laboratory note-book will receive careful attention at the time of the examination. It must contain a certificate from the teacher that it is a true record of the candidate's work.

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* Equivalent to the first half of Hygiene 1.

† Equivalent to, but not necessarily identical with, Physics *C*.

23. *Meteorology.* — A course of observational study equivalent to that described in a pamphlet entitled "An Outline of Requirements in Meteorology," issued by the University.

This course requires a knowledge of Elementary Physics. (For the form of examination see under Astronomy, below.)

24. *Astronomy.* — A course of observational study equivalent to that described in a pamphlet entitled "An Outline of Requirements in Astronomy," issued by the University.

This course requires a knowledge of Geometry.

In Physiography, Meteorology, and Astronomy, the candidate will be required to take both a written and a laboratory or practical examination. The written examination may test his understanding of observational methods appropriate to the subject, but will call chiefly for a knowledge of facts and principles. The laboratory or practical examination will test his skill in observation as well as his grasp of principles. This examination can be taken in Cambridge only; for those who are examined elsewhere in June, it will be postponed to September.

The laboratory examination in Physiography may include the description, explanation, and comparison of geographical features shown in photographs, maps, and models. The laboratory examination in Meteorology may include the use of instruments, the discussion of observations, and the construction and interpretation of weather maps and climatic charts. The practical examination in Astronomy may call for an ability to make simple naked-eye and instrumental observations, and to establish the simpler generalizations of astronomy by discussion of these observations.

The candidate in these subjects will be required to present, at the time of the laboratory or practical examination, the original note-book in which he recorded, with dates, the steps and results of the observations which he made at school. This book must bear the endorsement of his teacher, certifying that the notes are a true record of the pupil's work. An index of subjects should be appended. The note-book is required as proof that the candidate has formed the habit of keeping a full and intelligible record of his work through an extended course of observational study, and that his work has been of a satisfactory character; but greater weight will be given to the practical or laboratory examination than to the note-book in determining the candidate's attainments.

The following studies may be presented by candidates for admission to the Lawrence Scientific School: —

25, 26. Botany and Zoölogy.

25. *Botany.* — A course of study and laboratory work equivalent to that indicated in an "Outline of Requirements in Botany," issued by the University. The course should extend through at least half of a school year, with five lessons a week. The laboratory work is to be directed especially to the external anatomy and the activities of our common plants.

26. *Zoölogy.* — A course of study and laboratory work equivalent to that described in a pamphlet entitled "An Outline of Requirements in Zoölogy," issued by the University. The course should extend through at least half of a school year, with five lessons a week, and should include the laboratory study of at least ten types of animals, with special reference to their external anatomy and their activities. These types are to be selected in accordance with directions to be given in the pamphlet named.

In Botany and in Zoölogy the candidate will be required to pass both a written and a laboratory examination. The written examination will test the range and thoroughness of his knowledge of the subject. The laboratory examination will test his skill in observation and experimentation, and his ability to apply names properly to the parts of the organisms studied.*

At the time of the laboratory examination the candidate must present the original note-book containing (with dates) the notes and drawings he has made in the course of his laboratory work, and bearing the endorsement of his teacher, certifying that the book is a true record of the pupil's own observations and experiments. An index of subjects should be appended.

27-30. Shopwork.†

A course of instruction in the use of tools and in the ordinary processes employed in the working of wood or metal, equivalent to that described in a pamphlet entitled "An Outline of Requirements in Shopwork," issued by the University. The course may embrace one or more of the following divisions: —

27. *Wood-working;* **29.** *Chipping, Filing, and Fitting;*
28. *Blacksmithing;* **30.** *Machine-tool Work.*

The candidate must be familiar with the names, construction, and operation of the tools commonly used in these processes, and will be expected to read ordinary mechanical drawings and to make freehand sketches of articles which are to be produced in the workshop.

The candidate is required to pass both a written and a laboratory examination.* The written examination will test his knowledge of tools and mechanical processes, and of the properties of materials of common use in construction. He will be expected to show familiarity with approved methods for simple work in the branch in which he presents himself for examination, and to write an intelligible description of those methods, illustrated by such sketches as may be necessary to make them clear. The laboratory examination will test the candidate's skill in the use of tools. He will receive the materials and specifications for a piece of work, and will be expected to select his tools, preparing them for use if necessary, and to demonstrate satisfactorily his knowledge and skill.

Every candidate is further required to present the original note-book in which he entered the descriptions and sketches of the work he performed at school; and with this he may present, as evidence of his skill in the workshop, the models made by him at school. Both the note-book and the models must be accompanied by the endorsement of his teacher, certifying that the book is a true record, and that the models are specimens, of the pupil's own work.

31, 32, 33. Drawing.‡

A course of drawing, in either or both of the following branches equivalent to that described in an "Outline of Requirements in Drawing," issued by the University: —

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* For rules relating to laboratory examinations and note-books, see page 72.

† Each of the courses numbered 27–30 is to be equivalent to a half-course in the Lawrence Scientific School.

‡ Each of the courses numbered 31 and 32 is to be equivalent to a half-course, and 33 to a full course, in the Lawrence Scientific School.

31. *Freehand Drawing.* — The representation of simple objects, in outline and with shading.

Accuracy of delineation, correctness of proportion, and good quality of line are desired rather than any attempt at elaboration. The aim should be to express as much as possible with the fewest lines. The examination will consist of the drawing, first, of a group of geometrical solids, and, second, of either a simple piece of machinery or a simple piece of architectural ornament (such as a Greek anthemion), as the candidate may elect. Every candidate is further required to present a set of plates or drawings made by him at school, showing that he has completed a thorough course in this subject; and these drawings must be accompanied by the certificate of his teacher stating that they are the pupil's own work.

32. *Projections.* — The projection in plan and elevation of geometrical figures and of simple parts of architectural subjects or machinery.

The examination will test the candidate's knowledge of principles and methods. Every candidate is expected to bring to the examination the ordinary drawing instruments and lead-pencils; drawing-board and paper will be supplied. Every candidate is further required to present a set of plates or drawings prepared by him at school, sufficient to demonstrate his understanding of the subject and his familiarity with instruments, including the use of the right-line pen; and these drawings must be accompanied by the certificate of his teacher stating that they are the pupil's own work.

33. *Architectural Drawing.* — Elementary shades, shadows, and perspective. Thorough study of the forms of the Tuscan, the Greek Doric, the Ionic, and the Corinthian orders.

This course requires a knowledge of projections. Every candidate is expected to bring to the examination the ordinary drawing instruments and lead-pencils; drawing-board and paper will be supplied. Every candidate is further required to present a set of plates or drawings prepared by him at school, sufficient to demonstrate his understanding of the subject and his familiarity with instruments, including the use of the right-line pen; and these drawings must be accompanied by the certificate of his teacher stating that they are the pupil's own work.

The candidate will be required to pass a written and a drawing-room examination. The written examination will test his knowledge of the principles of shades, shadows and perspective, and his understanding of the simple forms of the orders and their mouldings. In the drawing-room examination the candidate will be required to draw from description in plan and elevation a simple architectural composition (such as a doorway) involving the use of an order. The drawing will be made in pencil with cast shadows in wash.

34, 35. Government and Economics.

34. *Civil Government.* — Civil Government in the United States (national, state, and local); its constitution, organization, and actual working.

The candidate will be expected to show, on examination, such general knowledge of the field as may be acquired from the study of a good text-book of not less than three hundred pages, supplemented by collateral reading, and discussion. The examination will call for the application of constitutional and political principles to concrete facts or cases, and for proof that the candidate has thought for himself about the subject as well as read about it.

For preparation in this subject, a course of study equivalent to at least three lessons a week for one year will be necessary.

35. *Economics:* —

The candidate will be expected to show, on examination, a knowledge of the leading facts and principles of Economics, including such subjects as division of labor, the factors of production, the laws of diminishing returns, demand and supply, value and price, wages, interest, rent and profits, credit, and international trade. For this part of the study one of the better grade of manuals in current use will serve as a basis, but it must be supplemented with collateral reading, discussion, and practical exercises. In addition to the study of principles, the student will be expected to have acquired a fair knowledge of elementary banking operations, and of the banking and monetary history of the United States since 1860.

For preparation in this subject, a course of study equivalent to at least three lessons a week for one year will be necessary.

Examination Papers.

A set of recent examination papers will be sent free on application to the Secretary, No. 16 University Hall. Separate papers may be had in quantities of not less than *six* copies of any *one paper* (not one each of six different papers) at ten cents a dozen on application to the Publication Agent of the University, No. 2 University Hall.

TIMES AND PLACES OF EXAMINATION.

Two regular examinations for admission to the Freshman Class of Harvard College and to the First-Year Class of the Lawrence Scientific School are held each year, — the June examination, at the beginning of the summer vacation, and the September examination before the beginning of the academic year in the autumn.

June Examinations.

In 1904, the *June examinations* were held on *Monday*, *Tuesday*, *Wednesday*, *Thursday*, *Friday*, *and Saturday*, *June 27*, *28*, *29*, *30*, *July 1*, *and 2*.

The examinations in June will probably be held at the following places: —

Cambridge, in Sever Hall.
Quincy, in the rooms of the Quincy High School.
Andover, in the rooms of Phillips Academy.
Milton, in the rooms of Milton Academy.
Groton, in the rooms of Groton School.
Southborough, in the rooms of St. Mark's School.
Worcester, in the rooms of the English High School.
Lynn, in the rooms of the Classical High School.
Springfield, in the rooms of the Springfield High School.
Fall River, in the rooms of the B. M. C. Durfee High School.
South Byfield, in the rooms of Dummer Academy.
Exeter, *N.H.*, in the rooms of Phillips Academy.
Concord, *N.H.*, in the rooms of St. Paul's School.
Portland, *Me.*, in the rooms of the Portland High School.
Newport, *R.I.*, in the rooms of the Rogers High School.
Pomfret Centre, *Conn.*, in the rooms of Pomfret School.
Washington, *Conn.*, in the rooms of the Gunnery School.
Lakeville, *Conn.*, in the rooms of the Hotchkiss School.
New York, *N. Y.*, in the rooms of the Board of Education, 59th Street and Park Avenue.
Tarrytown-on-Hudson, *N. Y.*, in the rooms of Hackley Hall.
Garden City, *N. Y.*, in the rooms of St. Paul's Cathedral School.
Albany, *N. Y.*, in the rooms of the Albany High School.
Buffalo, *N.Y.*, in the rooms of the Buffalo Central High School, corner of Court and Franklin Streets.
Morristown, *N.J.*, in the rooms of Morristown School.
Philadelphia, *Pa.*, in the rooms of the Young Men's Christian Association, 15th and Chestnut Streets.
Pottstown, *Pa.*, in the rooms of the Hill School.

Scranton, *Pa.*, in the rooms of the School of the Lackawanna
Pittsburg, *Pa.*, in the rooms of Shady Side Academy.
Washington, *D.C.*, in the rooms of the Central High School.
Louisville, *Ky.*, in the rooms of the Boys' High School, First Street.
Lima, *Ind.*, in the rooms of Howe School.
Milwaukee, *Wis.*, in the rooms of the East Division High School.
Cleveland, *O.*, in the rooms of the Central High School.
Cincinnati, *O.*, in the rooms of the Young Men's Christian Association.
Youngstown, *O.*, in the rooms of Rayen School.
Chicago, *Ill.*, in the rooms of the John Marshall High School, Adams Street.
Detroit, *Mich.*, in the rooms of Detroit University School.
St. Paul, *Minn.*, in the rooms of St. Paul Academy, corner Portland Avenue and Dale Street.
St. Louis, *Mo.*, in the rooms of the Board of Education, 9th and Locust Streets.
Kansas City, *Mo.*, in the rooms of the Central High School.
Denver, *Colo.*, in the rooms of the Denver High School (East Side), corner of Nineteenth and Stout Streets.
San Francisco, *Cal.*, in the rooms of the Mechanics' Institute, 31 Post Street.
Belmont, *Cal.*, in the rooms of Belmont School.
Portland, *Oregon*, in the lecture-room of the Portland Library.
Seattle, *Wash.*, in the rooms of the Central School Number 15.
Bonn, *Germany*, at the Hotel Kley.
Honolulu, *Hawaii*, in the rooms of Oahu College.

The University will ordinarily conduct the admission examinations in June in any school or city where a sufficient number of candidates shall present themselves for examination; provided that the school or city be not within easy reach of one of the regular places of examination. Applications for examinations in June, in schools or cities not named above, should be made to the Secretary of the Faculty of Arts and Sciences as early as *April 1*.

September Examinations.

The *September examinations* will be held *in Cambridge only* on *Monday*, *Tuesday*, *Wednesday*, *Thursday*, *Friday*, *and Saturday*, *September 19*, *20*, *21*, *22*, *23*, *and 24*.

Order of Examinations (June and September).

Monday, June 27 and September 19.

8 A.M. All candidates meet the officer in charge of the examinations.

9–10.	Elementary Physics.	2–3½.	Plane Geometry.
10½–12.	Elementary French.	2–4.	Geometry.
12¼–1¼.	Solid Geometry.	4½–6.	Elementary German.

Tuesday, June 28 and September 20.

8–9.	Physiography.	1½–3½.	Elementary English (*a*).
9¼–10¼.	Chemistry.	4–6.	Advanced Latin.
10¾–12¾.	Elementary Latin.		

Wednesday, June 29 and September 21.

8–9.	Logarithms and Trigonometry.	1½–3½.	Advanced French.
		4–6.	Advanced Greek.
9¼–10¾.	Elementary Algebra.	4–5.	Economics.
11–12½.	Elementary History.	5–6.	Civil Government.

Thursday, June 30 and September 22.

8–9.	Meteorology.	11½–12½.	Advanced Algebra.
9¼–11¼.	Elementary Greek.	1¾–3¾.	Advanced German.
9¼–10¾.	Harmony.	4–6.	Advanced History.

Friday, July 1 and September 23.

8–9.	Chipping, Filing, and Fitting.	10¼–12¼.	Counterpoint.
		11½–12½.	Wood-working.
8–10.	Architectural Drawing.*	1½–2½.	Advanced Physics.
9–10.	Blacksmithing.	3–6.	English (*b*).
10¼–11¼.	Machine-tool Work.		

Saturday, July 2 and September 24.

8–9.	Zoölogy.	11¾–12¾.	Anatomy, Physiology, and Hygiene.
9¼–10¼.	Astronomy.		
10½–11½.	Botany.	1½–4½.	Freehand Drawing.*
		4½–6½.	Projections.*

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* Examinations in Freehand Drawing, in Projections, and in Architectural Drawing are held in Cambridge only.

Laboratory Examinations.

A candidate who is examined in any study in which a laboratory examination is held will hand in his laboratory note-book at *the hour of the laboratory examination.* Laboratory note-books will be deposited, after examination, in the College office, where they will be kept for one year, subject to the order of the owners.

A candidate examined in June at any place where a laboratory examination is not provided will be required to take such an examination in Cambridge in the autumn; but if he passes the written examination in June and presents a satisfactory note-book, the subject will be temporarily counted in his favor in determining the question of his admission to the School. Similarly a Preliminary Candidate is allowed to postpone his laboratory examination until September of the year in which he enters the School.

Appointments for laboratory examinations will be made when the candidates meet the officer in charge of the examinations.

In June, classes from schools near Cambridge may, by special arrangement, take the laboratory examinations in Physics and Chemistry on earlier days.

Examinations in Freehand Drawing, in Projections, and in Architectural Drawing, are held in Cambridge only.

Good English.

Clear and idiomatic English is expected in all examination papers and note-books written by candidates for admission. Teachers are requested to insist on good English, not only in translations, but in every exercise in which the pupil has occasion to write or to speak English.

Examinations in Elective Studies.

Examinations in prescribed and elective studies that are not equivalent to admission studies are held only in the first fortnight of the academic year and only at Cambridge. Written notice of intention to take these examinations must be in the hands of the Secretary of the Faculty not later than *September 10.* The examinations in such elective studies as correspond to admission studies* are identical with the examinations in the latter, and must be taken at the same times and places.

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* As a rule, the Advanced Studies correspond to elective courses taught in Harvard College; and the standard of the entrance examinations is intended to be the same as that of the corresponding College courses. The following are the College courses to which admission studies correspond: Advanced Greek corresponds to Greek *A*, Advanced Latin to Latin *A*, Advanced German to German *C*, 1*a*, or 1*b*, Advanced French to French 1*c* or 1*a*, Logarithms and Plane Trigonometry to Engineering 1*b* or Mathematics A^1, Solid Geometry to Mathematics E^2, Advanced Algebra to Engineering 1*a*

OPTIONAL EXAMINATIONS FOR ADVANCED STANDING.

Anticipation of Prescribed Studies.

In addition to the examinations required for admission to the Scientific School, optional examinations are provided for such candidates as have extended their studies beyond the requirements.

I. A candidate may present himself for examination in any of the Advanced Studies not offered by him for admission, and thus qualify himself to pursue more advanced courses in those subjects in the School.

II. A candidate may present himself for additional examinations in courses which are of such a character that they may properly be anticipated by examination.

The examinations in prescribed first-year English and in courses which correspond to advanced admission studies* may be taken either in June or in September, or partly in June and partly in September.

The examinations in *other studies* are held *in the autumn only.* Written notice of intention to take these examinations must be in the hands of the Secretary of the Faculty of Arts and Sciences not later than *September 10.*

A student who has anticipated any of the studies of the first-year by means of the optional examinations may substitute in place thereof any prescribed or elective courses which he is qualified to pursue.

Examinations for advanced standing are held in such courses only as are intended primarily for undergraduates; and, among these, in such only as may reasonably be anticipated by examination. No laboratory course, no course in composition or discussion, and no other course in which an examination is obviously an inadequate test may be offered.

REGULATIONS CONCERNING STUDIES.

The Courses of Instruction named in the Annual Announcement (called "Elective Pamphlet") are provided by the Faculty of Arts and Sciences for all the students under its charge, whether registered in Harvard College, in the Lawrence Scientific School, or in the Graduate School; and a student in either of these schools makes his choice of studies according to the regulations of the School to which he belongs.

A student in regular standing in the Lawrence Scientific School may obtain admission to a course offered in any other department of the University by presenting to the Dean of that school an application, on an

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or Mathematics D^1, Advanced Physics to Physics *C*, and Meteorology to Geology B^2. Elementary German, French, Physics, and Physiography correspond to German *A*, French *A*, Physics *B*, and Geology A^1, respectively. Anatomy, Physiology and Hygiene corresponds to the first half of Hygiene 1. Elementary and Advanced German taken together correspond to German *B*.

official blank, certified by the Dean of the Lawrence Scientific School, and by giving satisfactory evidence of qualification for the course to the instructor who conducts it.

No student is admitted to any course offered by the Faculty of Arts and Sciences, unless he has fulfilled all the requirements for that course as stated in the Announcement, or otherwise satisfies the instructor that he is prepared to pursue it.

Every student must make his election so as to avoid conflict between the hours appointed for recitations or examinations in the courses which he chooses. No student will be examined in two courses of the same examination group, excepting half-courses not given in the same half-year, and a few courses specially mentioned in the Announcement.

The courses *for Undergraduates and Graduates* are, under certain limitations which are named in notes attached to the courses in the Announcement, open to any properly qualified student. But no starred(*) course may be taken by any student without the *previous consent* of the instructor.

No Scientific student is admitted to any course *primarily for Graduates* except on the written *recommendation* of the instructor. The Courses of Research and Seminary Courses may not be taken *by any student* without the *previous consent* of the instructor; and an undergraduate may not take in one year *more than one* Course of Research or Seminary Course.

Extra Studies.

A student who wishes, without assuming all the responsibilities of a regular study, to attend the instruction in any course, may do so on obtaining leave of the instructor; but no record will be kept of his attendance, and he will receive no credit in the books for work done in the course. A course so taken is called an *Extra Study*.

Deficiencies.

A student whose record is deficient at the beginning of any year is expected to pursue during that year such studies, in addition to those otherwise required, as may be necessary to make up the deficiency, or such part of the deficiency as the Administrative Board of the Lawrence Scientific School may determine, in accordance with the Regulations; and these studies will be treated in all respects as part of his regular work.

A student wishing to make up a deficiency in a prescribed course by passing *the mid-year and final examinations* in that course must obtain the consent of the Administrative Board of the School, and must give the Recorder notice *before December 20* of his intention to take the examinations.

GRADES OF SCHOLARSHIP.

The standing of every student in each of his courses is expressed, on the completion of the course, according to his proficiency, by one of five grades, designated respectively by the letters *A*, *B*, *C*, *D*, *E*.

Grade *A* denotes that the student has passed the course with *high distinction*; grade *B* denotes *distinction*; grade *C* denotes that the student has *satisfactorily* passed the course; grade *D* denotes that the student has *barely passed* the course; and grade *E* denotes *failure* to fulfil the requirements of the course.

At the close of each academic year, a list of the courses given in that year under the authority of the Faculty of Arts and Sciences, and of all students who have attained Grade *A* or Grade *B* in any of those courses, is printed; the names for each of the two grades being arranged, for each course, in alphabetical order. This list is sent to the father or guardian of every student in the Lawrence Scientific School, and may be obtained by other persons, on application. The complete record of each student's work (including notice of failure in any course) is sent, at the same time, to his father or guardian, or to the student himself.

Every student is required to satisfy the instructor in each of his courses, in such way and at such times as the instructor may determine, that he is performing the work of the course in a systematic manner. The instructor will provide tests, with sufficient frequency to give effect to this regulation, and will at once report to the Secretary the names of students who have not satisfied him that they are doing their work systematically.

Any instructor, with the approval of the Dean of the Lawrence Scientific School, may at any time exclude from his course a student who in his judgment has neglected the work of the course. Such exclusion shall be reported to the Administrative Board of the School at its next meeting. A student who has been excluded from any course may be required to place himself under the direction of a person approved by the Dean of the School.

DEGREE OF BACHELOR OF SCIENCE.

Degrees and Residence.

All degrees bestowed by the University are awarded by vote of the President and Fellows of Harvard College, with the consent of the Board of Overseers, and are publicly conferred by the President on Commencement Day.

The degree of Bachelor of Science is conferred on students recommended for this degree by the Faculty of Arts and Sciences.

The Statutes of the University require that no person shall be recommended for any of the ordinary degrees, except after thorough public examination, and a residence at the University for at least one year.

No year is counted to a student by the Faculty of Arts and Sciences as a full year of study towards a degree which is not devoted to studies approved by the Faculty, or under its authority, as suitable and sufficient to be so counted.

Conditions of Candidacy.

In order to become a candidate for the degree of Bachelor of Science the student must have been admitted to regular standing in the Lawrence Scientific School in one of the several four-year programmes of courses leading to that degree, and must have been registered as a candidate for the degree for at least one academic year.

Special students are not regarded as candidates for a degree.

In order to be recommended for the degree of Bachelor of Science, a student must have been registered in the Lawrence Scientific School as a candidate for that degree at least one academic year, and must have fulfilled the requirements for the degree in one of the programmes of study organized in this school.

The degree of Bachelor of Science *with distinction* is conferred in three grades: *summa cum laude*, *magna cum laude*, and *cum laude*.

The grade of the degree and the programme of study for which the degree is given are specified in the diploma.

Graduation in Three Years.

If a student has anticipated studies amounting to a substantial portion of the work of the First-Year, and desires to fulfil the requirements for the degree in three years, he may apply to the Administrative Board for leave so to do, specifying in his application the manner in which he proposes to arrange his studies for that purpose. The Administrative Board will decide on such applications according to the circumstances in each case.

Honors.

Students in the Scientific School may be candidates for Honors at graduation on the same terms as students in Harvard College. See *University Catalogue*, 1903–04, p. 496.

GRADUATION BOTH IN ARTS AND IN SCIENCE.

Students who wish to take the degree of Bachelor of Science in addition to the degree of Bachelor of Arts may register in the Lawrence Scientific School after their third year in Harvard College (or after the satisfactory completion of fourteen courses counting towards the degree of Bachelor of Arts). They will be recommended for the degree of Bachelor of Arts on the satisfactory completion of the required number of courses counting towards that degree, and for the degree of Bachelor of Science after completing the requirements for this degree in one of the programmes of study in the Scientific School.

It is desirable that students who contemplate taking their degrees in this way seek advice in the selection of their studies while registered in Harvard College, in order that they may enter the Scientific School fully prepared for the required work.

DEGREES OF MINING ENGINEER AND OF METALLURGICAL ENGINEER.

In order to be admitted to candidacy for the degree of Mining Engineer or Metallurgical Engineer, the applicant must be a Bachelor of Science in Mining and Metallurgy of Harvard University, or must have satisfied the requirements for that degree, or else must hold an equivalent degree from a College or Scientific School of good standing.

For such a candidate the requirements are a full year of residence in the Lawrence Scientific School, in which he shall be enrolled as a fifth-year student, and the completion with high credit of the studies specified below. No candidate will be recommended for the degree who does not satisfy the Department of Mining and Metallurgy, through such tests as it may impose, of the excellence of his attainments over his whole field of work.

Candidates for the degree of Mining Engineer are required to complete the following studies: Mining and Metallurgy 8, Mining and Metallurgy 17, Mining and Metallurgy 22 (for two courses), Mining and Metallurgy 24; Mineralogy and Petrography 12; and Engineering 7*a*. Geology 21 or 23 may be substituted for part of the work of Mining and Metallurgy 22, with the approval of the Department.

Candidates for the degree of Metallurgical Engineer are required to complete the following studies: Mining and Metallurgy 8, Mining and Metallurgy 15, Mining and Metallurgy 20, Mining and Metallurgy 26 (for three courses), and Engineering 7*a*.

FELLOWSHIPS, SCHOLARSHIPS, AND PRIZES.

FELLOWSHIPS.

Graduates of the Scientific School may be appointed to a Parker Fellowship, the John Thornton Kirkland Fellowship, the Hemenway Fellowship, the Morgan Fellowships, and the John Tyndall Scholarship. For full information, see *University Catalogue*, 1903–04, pp. 525 et seq.

Nelson Robinson Jr. Travelling Fellowship in Architecture.

This fellowship, with an income of one thousand dollars, was established in 1902 by vote of the President and Fellows, from the income of the Nelson Robinson Jr. Fund, for Bachelors of Science in Architecture of Harvard University who have taken the degree *with distinction* or who have completed with distinction a year of Graduate study in Architecture at the University. The selection among those admitted to candidacy will be made on the results of a competitive examination in the history of architecture and in design, to be held in Cambridge in the month of April of each year. Applications of candidates must be sent to the Chairman of the Committee on Fellowships and other Aids for Graduate Students before the first day of January of the year in which the candidates expect to present themselves for examination. Travel and study in Europe are required.

The holder of this fellowship is not to be more than twenty-six years of age at the time of his appointment.

Eight fellowships, with an income of five hundred dollars each, were established in 1899 by a vote of the President and Fellows, setting apart for the purpose a portion of the income of the fund received by the University under the will of Edward Austin (see p. 571 University Catalogue). In 1903 the number was increased to twenty. These fellowships are awarded by the Corporation on the recommendation of a Division or Department of the Faculty of Arts and Sciences. The incumbents, while employed as instructors or assistants under the Faculty, are allowed to devote half their working time to advanced study or research under the direction of their several Divisions. One or more of these fellowships may be awarded to students in the Lawrence Scientific School.

Austin Resident Scholarships in Architecture.

The President and Fellows of Harvard College have established two Austin Resident Scholarships in Architecture, each with an income of three hundred dollars, setting apart for this purpose a portion of the income received by the University under the will of the late Edward Austin. These Scholarships are open to Bachelors of Science in Architecture of Harvard University who wish to spend a year in advanced study in architecture at the University. They will be awarded by the President and Fellows on the nomination of the Faculty of Arts and Sciences.

Austin Resident Scholarship in Landscape Architecture.

The President and Fellows have also established from the Austin Fund one Austin Resident Scholarship in Landscape Architecture, of the annual value of three hundred dollars, which is open to Bachelors of Science in Landscape Architecture for advanced study in this subject on the same terms as the Scholarship in Architecture.

Applications for these Resident Scholarships must be in the hands of the Chairman of the Committee on Fellowships not later than March 15th of each year.

SCHOLARSHIPS.

The scholarships are restricted to resident students. Appointments are made by the President and Fellows of Harvard College, on nomination by the Faculty of Arts and Sciences.

Applications from students in the Lawrence Scientific School should be filed with the Secretary of the School on or before *June 1*.

Scholarships are awarded at the beginning of each academic year to meritorious students standing in need of such assistance.

Payment of Income.

To resident holders of fellowships and scholarships having stipends the income thereof is payable at the Bursar's Office, two-thirds *February 1*, and the remainder *one week before Commencement;* but the income will be first applied to the settlement of any College term-bills issued and unpaid, and any balance then remaining will be paid in money.

The income of non-resident fellowships, having stipends, is payable quarterly in advance by drafts sent from the Bursar's Office *September 1*, *December 1*, *March 1*, and *June 1*. The first payment of the year is due September 1 for the quarter ending November 30; but to any holder of a fellowship who is going abroad to study, the income for six months to March 1 in the first year of his appointment will be paid at his request on or before September 1. No remittance will be made to the holder of a fellowship for any quarter until there is received from him at the Bursar's Office the address to which he desires to have it sent, unless he requests in writing that all remittances be sent to a stated address until he gives notice of a change.

The Francis Hathaway Cummings Scholarship (**G. S.**, **L. S. S.**, and **B.**); with an income of two hundred dollars. Founded in 1898, with a principal of five thousand dollars, by Charles A. Cummings and Margaret K. Cummings, in memory of their son, Francis Hathaway Cummings, of the Class of 1895. The income of this scholarship is "to be used for the benefit of students of proved merit who hold the degree of Bachelor of Arts from Harvard College, who need assistance, and who wish to pursue, either in the Graduate School, the Lawrence Scientific School or the Bussey Institution a course of study in Applied Botany or in such other branches of the University teaching as will best prepare them for the profession of Landscape Gardener, or for the efficient practice of Horticulture, Arboriculture or Forestry."

The Joseph Eveleth Scholarships (**H. C.** and **L. S. S.**); with an income of two hundred dollars each. Founded from the residuary bequest, received in 1896, of thirty-seven thousand eight hundred and ninety-seven dollars and fourteen cents, made by Joseph Eveleth, of Boston and Watertown, Sheriff of Suffolk County from 1840 to 1855 except in 1853; "for aiding deserving and indigent young men in obtaining an education in said College or any of the schools connected therewith." Eight scholarships have been established on this foundation, of which three are assigned to the Lawrence Scientific School; three to the Medical School; and two to Special Students in Harvard College.

The Hilton Scholarships (**H. C.** and **L. S. S.**); with an income of two hundred and twenty-five dollars each. Founded in 1897, from a bequest of William Hilton, of which the sum of twenty-two thousand five hundred and fifty-three dollars and sixty-seven cents has been received. Four scholarships exist on this foundation; of which one is assigned to Harvard College, one to the Lawrence Scientific School, and two to the Medical School.

The Hennen Jennings Scholarship (**L. S. S.**); with an income of four hundred dollars. Founded in 1898, with a principal of ten thousand and seventy-two dollars and forty cents, by Hennen Jennings, a graduate of the Lawrence Scientific School in the Class of 1877. The full yearly interest of this fund is to be used for one scholarship, and is not to be given "merely as a charity to mediocre ability," or to "students whose own private means are sufficient for all their requirements."

The Lawrence Scientific School Association Scholarship (**L. S. S.**); with an income of one hundred and fifty dollars. This scholarship is maintained by the Lawrence Scientific School Association for a student in the Lawrence Scientific School, and "may be awarded to meet the expenses of the summer scientific studies of a student who already holds another scholarship."

The Dunlap Smith Scholarship (**H. C.** or **L. S. S.**); with an income of two hundred dollars. Founded in 1903 by the Harvard Club of Chicago, with a principal of five thousand dollars in bonds, in memory of Dunlap Smith, of the Class of 1884, one of the ex-presidents of the Club. "The Club requests that the income from this fund shall be paid annually to some meritorious student in the undergraduate department of Harvard College or the Lawrence Scientific School; preference, upon application, however, to be given — First, to the sons of Dunlap Smith; Second, to the sons of present members of the Harvard Club resident at the time of application in Chicago or its vicinity; and Third, to other residents of Chicago or its vicinity."

The Normal School Scholarships (**L. S. S.**); not exceeding four at any one time, with an income of one hundred and fifty dollars each. Maintained by the University, under a vote of the President and Fellows passed March 8, 1880, for the benefit of students in the Lawrence Scientific School who are graduates of reputable Normal Schools in the United States.

The University Scholarships (**L. S. S.** and **G. S.**); with an income of one hundred and fifty dollars each. Maintained by the University under a vote of the President and Fellows; eight being assigned to the Lawrence Scientific School, and ten being assigned to the Graduate School.

PRIZES.

Students in the Lawrence Scientific School may compete for the Bowdoin, Dante, Sales, and Sumner Prizes. For full information in regard to them see *University Catalogue*, 1903–04, p. 514 *et seq.*

OTHER SOURCES OF AID.

LOAN-FUNDS.

In addition to the scholarships, which are enumerated in the preceding section the following funds have been established.

Repaid Loans Fund. By vote of the President and Fellows of Harvard College, money repaid by former students from year to year for loans made to them while members of the Scientific School, is placed in the hands of the Dean of the School to be loaned to meritorious students who need such aid in the payment of their school expenses.

The Edward Austin Fund. In 1899, the sum of four hundred and twenty-five thousand dollars was received by the College in the settlement of the bequest of five hundred thousand dollars, made by Edward Austin, who gave Austin Hall to the Law School, the income thereof to be paid to "needy, meritorious students and teachers to assist them in payment of their studies." In 1900 W. A. Wadsworth and Herbert Wadsworth gave twenty-five thousand dollars to be added to this fund. Two thousand dollars from the income of this fund is loaned to students in the Lawrence Scientific School.

Stuart Wadsworth Wheeler Fund. In 1898, Mrs. Susan Wheeler gave to the College as a memorial to her son, Stuart Wadsworth Wheeler, a former student in the University and a soldier in the Spanish War, five thousand dollars "towards the fund for helping poor students." The income of this fund has been placed by the Corporation at the disposition of the Dean of the Lawrence Scientific School, to whom application should be made.

OPPORTUNITIES FOR EARNING MONEY.

Opportunities frequently present themselves by which students who need to increase their income may obtain, in term-time or in vacation, employment of various kinds, such as typewriting, stenography, canvassing, office work, newspaper work, singing, and, after the first year, private tutoring. Students who wish to be regarded as applicants for such employment should register their names, with a statement of their qualifications and of the kind of work they desire, with the *Chairman of the Appointment Committee*, No. 9, University Hall.

FEES AND EXPENSES.

TUITION-FEES.

For a Student in Regular Standing.

The annual tuition-fee for every student in regular standing in Harvard College or the Lawrence Scientific School, and for every Resident Student in the Graduate School doing full work, is *one hundred and fifty dollars*.

A student paying this fee is entitled to all the general privileges of membership in the University. He has the right to take any courses for which he is qualified, given under the authority of the Faculty of Arts and Sciences; but in laboratory courses he must pay certain additional fees, named below. He has also the right of free admission, provided he is properly qualified, to any of the instruction and the examinations given in any department of the University; except exercises carried on in special laboratories. To obtain admission to instruction given in a department not under the charge of the Faculty of Arts and Sciences, a College or Graduate student should apply to the Recorder for a certificate to be presented to the Dean of the department in which the desired instruction is given. A Scientific student should apply, in like manner, to the Secretary of the Scientific School.

In Harvard College and the Lawrence Scientific School, *all students not Special Students* are required to pay the full tuition-fee of one hundred and fifty dollars. The same fee is charged to Special Students doing full work; as well as to every Resident Student in the Graduate School who is doing full work, or who wishes to have the year counted to him as a complete year of study for any degree, or who holds a fellowship or scholarship. Laboratory fees must be paid in addition to the tuition-fee by students who take laboratory courses.

A student who enters the University after the beginning of the academic year is charged one hundred and fifty dollars for instruction if he enters prior to January 1; one hundred dollars if he enters between December 31 and April 1; and fifty dollars if he enters after March 31. One who withdraws during the first third of the year is charged fifty dollars, if, before January 1, he gives written notice of his withdrawal to the Dean of the School; one who withdraws during the second third is charged one hundred dollars, if he gives written notice before April 1; otherwise he is charged to the end of the third in which such written notice is given.

The first third of the academic year begins with the academic year, and ends *December 31*. The second third begins *January 1* and ends *March 31*. The last third begins *April 1* and ends at *Commencement*.

Deduction from the full tuition-fee of one hundred and fifty dollars a year is made for properly notified absence, as follows: for absence for three consecutive months, *thirty dollars;* for absence during the whole year, not including the mid-year and final examinations, or either of them, *one hundred dollars.* A student who claims a deduction, on the ground of absence, must present at the Bursar's office a certificate from the Recorder as to the fact and duration of his absence; and in order to obtain such a certificate, he must have given previous notice of his intended absence to the Dean or to the Recorder.

Every Non-Resident Student in the Graduate School, not holding a fellowship, is required to pay at least *thirty dollars* to the University. Non-resident holders of fellowships are charged no fees.

A fee of *three dollars* is charged for the second and each subsequent examination for removing a condition.

The fee for the examination for the degree of Ph.D. or S.D. is *thirty dollars*, but this fee is not charged to any candidate who has paid the full tuition-fee of one hundred and fifty dollars for at least one year as a Graduate Student.

Fees for Single Courses.

Special Students and Students in the Graduate School (not doing full work) may pay fees for the courses which they take, instead of paying the full tuition-fee of a student in regular standing. But a student paying less than one hundred and fifty dollars is not allowed to be the holder of a fellowship or scholarship, or to count the year as a full year of study for a degree, or to claim admission to instruction or examination in another department of the University.

The fees for single courses are as follows: —

For any Course of Instruction, not a Laboratory Course or Course of Research, and for any Laboratory Course designed "primarily for Undergraduates," *forty-five dollars* for a full course, *twenty-five dollars* for a half-course.

For a Laboratory Course designed "primarily for Graduates" or "for Undergraduates and Graduates," *one hundred and fifty dollars.*

For a Course of Research, such amount, *not less than forty-five dollars,* as shall represent the weight of the course in the student's plan of work.

In all other cases the fee is computed at the rate of *fifteen dollars for an hour a week* of instruction during the academic year, up to one hundred and fifty dollars.

In no case shall the tuition-fee for the year be less than *thirty dollars* or more than *one hundred and fifty dollars.*

No deduction for absence or withdrawal is made from the fees for single courses. A student who attends a Course of Instruction for only a part of the year must pay the whole fee for such course. But a student who is liable for the full tuition-fee of *one hundred and fifty dollars* a year is entitled to the same remission as a student in regular standing.

Infirmary Fee.

Beginning with the academic year 1904–05, a fee of four dollars a year will be charged to every student in Harvard College, to every student in the Scientific School, and to every Resident Student registered in the Graduate School, for the maintenance of the Stillman Infirmary; and, on the order of a physician, every such student will be given, in case of sickness, in return for this fee, a bed in a ward, board, and ordinary nursing for a period not exceeding two weeks in any one academic year.

Graduation Fee.

A graduation fee of twenty dollars is charged to all students taking the degree of Ph.D., S.D., A.M., S.M., M.E., or Met. E.; to all students taking the degree of A.B. who have incurred fewer than four years' full tuition-fees as members of the College; and to all students taking the degree of S.B. who have incurred fewer than four years' full tuition-fees as members of the Scientific School. In the application of this rule, no student will be considered a member of more than one department at the same time.

Laboratory Fees.

Every student who takes a Laboratory Course must pay, in addition to his tuition-fee, the special fees pertaining to such course.

For Laboratory Courses in Engineering, the fees vary from *one dollar* to *sixteen dollars.* In Physics, the fees vary from *ten* to *fifteen dollars.* For study in the Chemical Laboratory, there is a general fee, which varies from *nine dollars* to *thirty-six dollars*, according to the nature and amount of the work undertaken, and also an individual fee for the use of materials in special investigations and for breakage, and in payment of fines for violation of the laboratory regulations. For each Laboratory course in Botany, Zoölogy, Psychology, and Hygiene, the fee is *ten dollars.* In Geology, the fees vary from *five dollars* to *twenty dollars.* In Mineralogy, they vary from *five dollars* to *thirty dollars.* In Mining and Metallurgy, the fees for ordinary courses vary from *fifteen dollars* to *thirty dollars;* while in the research courses the minimum fee is *thirty dollars.*

BONDS.

Every student in Harvard College or in the Lawrence Scientific School in regular standing must file with the Bursar a bond in the sum of *four hundred dollars*, signed by two bondsmen, one of whom must be a citizen of the United States, or by a surety company duly qualified to do business in Massachusetts, as security for the payment of College bills; or he may deposit with the Bursar four hundred dollars in United States bonds, for the same purpose; or he may deposit *fifty dollars* as security, and pay his tuition-fees in advance, as follows: — one third on or before *October 1*, one third on or before *January 1*, and one third on or before *April 1.* Money deposited as security is returnable after the issue of the second term-bill, one week before Commencement.

The same rule applies to every Special Student in Harvard College or in the Lawrence Scientific School, and every Resident Student in the Graduate School; except that *two hundred dollars* is the amount of the bond or deposit required of a student of one of these classes, unless he occupies a College room or boards at Memorial Hall or Randall Hall.

Every student in any department of the University who occupies a College room or boards at Memorial Hall or Randall Hall must file a bond for *four hundred dollars*, or must in advance, and in addition to his tuition-fees, pay the full year's rent of his room, and make a deposit as security for the payment of his board at the rate of *five dollars a week.*

No officer or student of the University is accepted as a bondsman.

PAYMENT OF FEES, ETC.

Each student who files a bond or deposits United States bonds must pay his tuition-fee in advance to the Bursar, as follows: —

(1) On or before October 12, 1904, at 1 P.M., ninety dollars, or the whole of his fee for the year, if it does not exceed ninety dollars.

(2) On or before February 11, 1905, at 1 P.M., the remainder of his fee for the year.

No bill is issued, in advance, for the tuition-fee; but a receipt is given at the time of payment.

Term-bills, for dues other than tuition-fees, will be issued as follows:

The first term-bill will be issued January 23, 1905, and must be paid on or before February 11, 1905. This bill will include such charges as the following: Two-thirds of the year's charges for the use of a College room; fees for laboratory courses which begin in the first half-year; Stillman Infirmary fee; locker fees; such incidental charges as can then be determined; charges for gas, and for board at the Harvard Dining Association and the Randall Hall Association, made up to as late a date as practicable.

The second term-bill will be issued one week before Commencement, and will contain the charges not included in the first bill. The second term-bill must be paid by all candidates for degrees at least one day before Commencement; and, by all other students, on or before July 25, 1905.

Students who are candidates for degrees in the middle of the academic year must pay all dues to the University, at least one day before the day upon which the degrees are to be voted.

When a student's connection with the University is severed, all charges against him must be paid at once.

Each student whose dues to the University remain unpaid on the day fixed for their payment is required at once to cease attending lectures or recitations, using the libraries, laboratories, gymnasium, athletic grounds or buildings, boarding at the Harvard Dining Association or at the Randall Hall Association, and making use of any other privileges as a student, until his financial relations with the University have been arranged satisfactorily to the Bursar. Failure to comply with this rule is deemed cause for final separation of the student from the University.

EXPENSES.

The following table exhibits four scales of annual expenditure: —

	Low.	Moderate.	Liberal.	Very liberal.
Tuition	$150	$150	$150	$150
Room (one-half)	30	50	100	200
Furniture (annual average)	10	15	25	50
Board (39 weeks)	117	160	160	390
Fuel and light	11	15	30	45
Stillman Infirmary fee . .	4	4	4	4
Sundries	40	60	100	200
Total	$362	$454	$569	$1039

The above estimates do not include laboratory charges, books and stationery, clothing, washing, membership of societies, subscriptions, service, and the expenses of the long vacation; some of which are luxuries, and all of which vary with the means and habits of the individual student. The exceptionally strong and capable student can, without injury to himself, reduce his necessary expenses below the lowest estimate presented in the above table, which may be regarded as a fair one for a student of ordinary constitution and power of self-command. Information regarding rooms in College buildings may be obtained after April 6, upon application to the Bursar. During the course of the summer a list of available rooms outside the College buildings may be obtained from the Secretary of the Faculty or at the Publication Office.

A committee of officers and students have charge of some hundred sets of chamber and study furniture which are rented at low rates.

Members of any department of the University can board at cost by joining the Association which uses the great dining-room of Memorial Hall, but the total membership is necessarily limited to about 1100. The cost of board to the members of this Association is expected not to exceed $4.25 a week. Applications for seats for the year 1904–05 should be made before September 15, 1904, to the Auditor of the Dining Association, Memorial Hall. The Hall opens on the last Wednesday in September.

Upwards of eleven hundred members of the various departments of the University are admitted annually to the the Randall Hall Association, a coöperative organization having quarters adjoining the College Yard. Simple articles of food are furnished to order at cost, so that it is possible to board at Randall Hall for from $2.50 to $3.00 a week or less. The annual fees of the Association are low. Application should be made early to the Secretary of the Randall Hall Association.

The Harvard Coöperative Society is another organization for reducing expenses. At the store of the Society, clothing, books, stationery, wood, coal, etc., can be purchased at reduced prices.

ASSIGNMENT OF COLLEGE ROOMS FOR 1904–05.

Students living in buildings inside the College Yard, who intend to be Undergraduates or Special Students in the College or in the Scientific School during the academic year 1904–05; and all students living in College buildings outside the Yard, who intend to be students in any department of the University during the academic year 1904–05, may engage for that year the rooms which they now occupy by signing new room-agreements and leaving them at the Bursar's office between March 21 and March 31 inclusive. Students who, in 1904, receive the degree of A.B. or of S.B. *as of* 1905, will have the same rights as Seniors; but other holders of academic degrees will not be considered as Undergraduates in the assignment of rooms in the Yard.

A list of all the College rooms not engaged for 1904–05, except rooms in Wadsworth House, and a few rooms in Holyoke House, with blank forms of application, will be ready for delivery at the Bursar's office April 6. Applications for these rooms may be made on or before May 2 by those who intend to be students in the University during the year 1904–05. Applications which are not made on the printed blanks, and applications from those who have already engaged College rooms for

1904–05, will not be considered. The assignment of rooms will be made by lot May 4, and the result of the allotment will be announced May 5.

Lists of the rooms to be let May 4, descriptive lists of rooms, blank applications and bonds will be sent after April 6 to those intending to enter the University in the summer of 1904 who send their names and addresses to the Bursar for that purpose. The application will contain a certificate to be signed by the instructor of the applicant stating that the applicant intends to enter the University in the summer of 1904, and specifying the department he intends to enter, and the examinations (June or September) at which he will apply for admission. The bond for $400 must be executed by two sufficient bondsmen or by a surety company duly qualified to do business in Massachusetts, and will hold them for the full year's rent of any one of the rooms applied for which may be assigned to the applicant between the date of the execution of the bond and the fifth day of October, 1904, unless the applicant is rejected at the June examinations without permission to take the examinations in September; and in that case the bondsmen will be held for one quarter of the full year's rent. But the bondsmen will not be held for any payment of rent if the Bursar lets the room to some other member of the University in accordance with the established rules.

In the assignment of rooms inside the Yard, preference will be given to applicants who will be Undergraduates in the College or in the Scientific School during the academic year 1904–05; and in the assignment of rooms in Hollis Hall, Stoughton Hall, and Holworthy Hall, preference will be given to applicants who, during that year, will be members of the Senior class in the College, or of equivalent rank in the Scientific School. No student may become the room-mate of one who has obtained his room through the above preference, unless he himself is entitled to a like preference. In the assignment of a room with two bedrooms, preference* will be given to an application signed by two students who will occupy the room together. If two students, neither of whom has a room standing in his name for 1904–05, intend to occupy a room together and both sign one application, this application will be given two chances in the allotment and any room drawn will be assigned to the two applicants. But if in any case one of two applicants to whom a room has been assigned is not admitted to College at the examination specified by the instructor on the room-application, or if either of the applicants does not register and join his class before October 1, or does not occupy the room through the year, the Bursar may cancel the assignment and assign the room by lot to other applicants.

Every student to whom a room is assigned, except any applicant for admission who is rejected at the June examinations without permission to take the examinations in September, will be held responsible for the full year's rent thereof, and all charges for gas and damages, unless, before October 1, 1904, the room is let at his request to some other student in accordance with the established rules; or unless, being a member of the class of 1905, of 1906, or of 1907, in the College, he permanently severs his connection with the University, obtains a leave of absence for the whole year 1904–05, or is suspended for the whole of that year, and gives written notice to the Bursar before September 1, 1904, that he desires to cancel his room-agreement. When one of two room-mates cancels his room-agreement under the preceding provision, the other room-mate may, except as otherwise provided in the case of rooms assigned by preference to two applicants, secure the room by at once signing a new room-agreement and leaving it at the Bursar's office; but unless he does so, the Bursar will be at liberty to assign the room to other tenants.

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* In Holyoke House, rooms 5, 16, 27, and 38 only, will be subject to this preference.

Students who have no College rooms for 1904–05 and wish to obtain rooms which may be unengaged May 9, or which may become vacant at any time after that date, may after May 4 file applications at the Bursar's office, specifying the conditions as to buildings, floors, exposure, rent, etc., which they desire to have met, and containing agreements to take any rooms which may be assigned to them which fulfil the specified conditions. These applications will remain in force until such dates as the applicants may specify therein, and rooms will be assigned upon them by lot. Notice of rooms to be assigned may be put upon the bulletin board if the Bursar considers it advisable.

The Bursar may cancel the assignment of a room to one whose connection with the University as a student is terminated; or to one intending to enter College as an undergraduate who does not pass the admission examination or, having passed the examination, does not join his class before October 1, 1904; or to any other person who does not register as a student in some department of the University before October 1, 1904.

The right to occupy a College room is given only to the student to whom the room is assigned and to his room-mate. Neither transfers nor exchanges of rooms are allowed. Not more than two students are allowed to occupy any College room; and not more than one to occupy any room in Divinity Hall except those having bedrooms, nor any room on the North side of Grays Hall, nor Nos. 18, 30, and 42 in Conant Hall. Only the constant use of a room by night as well as by day will be regarded as occupation thereof. All persons who occupy College rooms are subject to the regulations of the Parietal Board. Persons not connected with the University are not allowed to occupy College rooms. Tenants who desire to employ any one to make fires, black boots, etc., must arrange therefor with the porters of the buildings in which they live.

PRICES OF COLLEGE ROOMS FOR 1904-05.

In each case the price is for the whole room from the beginning of the Academic Year until the next Commencement, and includes the daily care of the room. The prices of rooms in Hollis and Stoughton; of Walter Hastings, No. 61; Conant, Nos. 33 and 45; and Gannett, No. 9, include heat.

Rooms thus (*) designated are furnished with bedstead, spring, mattress, pillow, washstand, chiffonnier, desk, chairs, bookshelves, and rug. The other rooms are unfurnished.

$30.	College House, No. 35.
$45.	Divinity, No. 10.
$50.	College House, Nos. 57 and 58; Divinity, No. 5.
$55.	College House, No. 66; Divinity, Nos. 2, 3, 6*, 14.
$60.	College House, Nos. 22, 44; Divinity, Nos. 1, 4*, 9*, 12*, 13.
$65.	Grays, Nos. 33, 35; College House, Nos. 46, 48, 50, 52, 54, 60, 62, 64; Divinity, Nos. 11*, 20.
$70.	College House, Nos. 3, 4, 6, 7, 8, 9, 10, 15, 16, 18, 19, 20, 25, 26, 27, 28, 30, 31, 32, 37, 38, 39, 40, 41, 42; Divinity, Nos. 18, 28.
$75.	College House, Nos. 47, 49, 51, 53, 59, 61, 63, 69, 70; Divinity, Nos. 7*, 8*, 24*, 34*, 35, 38*.
$80.	Grays, No. 34; College House, Nos. 11, 33, 45, 55, 65, 67, 68; Divinity, Nos. 26*, 32*, 40*, 41, 42*.
$85.	Grays, Nos. 13, 15, 49, 51; College House, Nos. 1, 2, 21, 23, 24, 43; Divinity, Nos. 17, 19, 21*, 23, 25, 29, 31, 33, 36*, 37, 39.
$90.	Weld, Nos. 25, 26, 52, 53; Grays, Nos. 3, 17, 19, 37; Divinity, Nos. 16*, 27*, 30*.
$100.	Holyoke, Nos. 39, 45; Foxcroft, Nos. 3, 5; Walter Hastings, No. 61; Wadsworth, Nos. 9 and 10, 11 and 12.
$105.	Grays, No. 36.
$110.	Grays, Nos. 14, 29, 31.
$115.	Hollis and Stoughton, Nos. 1, 2, 3, 4, 17, 18, 19, 20; Grays, Nos. 1, 11, 18, 25, 27, 39, 45; College House, No. 29.
$120.	Weld, Nos. 24, 27, 51, 54; Grays, No. 21.
$125.	Weld, Nos. 9, 36; Matthews, Nos. 27, 28, 57, 58; Holyoke, Nos. 6, 17, 28, 46; Foxcroft, Nos. 1, 2, 6, 9, 12, 15, 16; Gannett, No. 7; Walter Hastings, Nos. 13, 22, 23, 32, 46, 59; Perkins, Nos. 3, 4, 6, 7, 8, 9, 10, 11, 12, 49, 50, 51, 52, 54, 55, 56, 57, 58; Conant, Nos. 18, 30, 42.
$130.	Thayer, Nos. 17, 18, 19, 20, 41, 42, 65, 66.
$135.	Hollis and Stoughton, Nos. 14, 16, 29, 30; Stoughton, No. 13; Thayer, Nos. 23, 24, 47, 48; Grays, Nos. 16, 30, 50, 52.

$140.	Hollis and Stoughton Nos. 5, 6, 8, 9, 10, 11, 12, 22, 23, 24, 25, 26, 27, 28; Hollis, Nos. 7, 21; Stoughton, No. 15; Grays, Nos. 2, 9, 26, 40, 47.
$145.	Hollis and Stoughton, No. 32; Grays, No. 22.
$150.	Holyoke, Nos. 2, 3, 34, 40, 44; Foxcroft, Nos. 4, 7, 13, 14; Gannett, No. 9; Walter Hastings, Nos. 45, 60; Perkins, Nos. 1, 2, 15, 16, 18, 19, 20, 21, 22, 23, 24, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88.
$160.	Thayer, Nos. 13, 14, 15, 16, 35, 36, 43, 44, 59, 60, 67, 68; Grays, No. 32; Matthews, Nos. 25, 26, 29, 30, 55, 56, 59, 60.
$165.	Thayer, Nos. 1, 2, 3, 4, 63, 64; Grays, Nos. 4, 10, 12, 20, 28, 38, 46, 48; Matthews, No. 6.
$170.	Hollis and Stoughton, No. 31; Thayer, Nos. 25, 26, 49, 50; Grays, Nos. 6, 8, 42, 44.
$175.	Thayer, Nos. 45, 46; Holyoke, Nos. 11, 12, 22, 23, 29, 35, 37, 41, 42, 43, 47; Foxcroft, No. 8; Perkins, Nos. 13, 14, 25, 26, 37, 38.
$185.	Weld, Nos. 3, 5, 13, 14, 19, 20, 30, 32, 40, 41, 46, 47.
$190.	Thayer, Nos. 5, 6, 8, 9, 10, 11, 12, 37, 38, 39, 40, 57, 58, 61, 62; Weld, Nos. 8, 34; Matthews, Nos. 9, 15, 39, 45.
$200.	Thayer, Nos. 21, 22, 31, 51, 52, 56; Holyoke, Nos. 13, 18, 24, 26, 30, 31, 32, 36, 38, 48; Gannett, Nos. 3 and 4, 6; Conant, Nos. 3, 4, 5, 7, 8, 9, 10, 11, 12, 39, 43, 46, 47; Wadsworth, Nos. 1 and 2, 13, 14.
$210.	Conant, Nos. 40*, 41*, 44*, 48*.
$215.	Matthews, Nos. 22, 52.
$220.	Thayer, Nos. 33, 34; Weld, No. 1; Matthews, Nos. 3, 4, 33, 34.
$225.	Thayer, Nos. 27, 28, 32, 55; Matthews, Nos. 10, 16, 46; Holyoke, Nos. 1, 4, 8, 9, 10, 14, 15, 19, 20, 21, 25, 50; Gannett, Nos. 1, 2; Walter Hastings, Nos. 20, 30, 42; Conant, Nos. 1, 2, 15, 16, 19, 20, 21, 22, 23, 24, 28, 29, 36; Wadsworth, No. 5 and 6.
$230.	Conant, No. 45*.
$235.	Conant, Nos. 27*, 31*, 32*, 34*, 35*.
$240.	Weld, Nos. 18, 21, 22, 23, 45, 48, 49, 50.
$245.	Weld, Nos. 4, 12, 15, 39, 42; Matthews, Nos, 19, 20, 21, 49, 50, 51; Conant, No. 33.
$250.	Weld, Nos. 6, 31, 33; Matthews, No. 5; Holyoke, Nos. 27, 49; Gannett, Nos. 5, 8; Walter Hastings, Nos. 14, 16, 18, 24, 26, 28, 33, 36, 39, 47, 50, 53, 56; Conant, Nos. 13, 14, 25, Wadsworth, Nos. 3 and 4, 7 and 8, 15.
$260.	Conant, Nos. 26*, 37*.

$265.	Matthews, Nos. 23, 24.
$270.	Weld, Nos. 16, 17, 43, 44.
$275.	Holworthy, Nos. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16, 17, 18, 19, 21, 22, 23, 24; Weld, Nos. 2, 10, 11, 28, 29, 37, 38; Matthews, Nos. 1, 2, 8, 13, 14, 31, 32, 35, 36, 37, 38, 43, 44; Holyoke, Nos. 5, 16.
$290.	Matthews, Nos. 53, 54.
$300.	Walter Hastings, Nos. 12, 21, 35, 38, 41, 44.
$325.	Matthews, Nos. 11, 12, 17, 18, 41, 42, 47, 48; Walter Hastings, Nos. 3, 6, 9, 11, 15, 17, 19, 25, 27, 29, 31, 34, 37, 40, 43, 57, 58.
$350.	Walter Hastings, Nos. 1, 2, 4, 5, 7, 8, 10, 48, 49, 51, 54, 55.

Divinity Hall is reserved primarily for students of the Divinity School, and rooms in this building will not be assigned to other students until the Thursday on which the academic year begins. Applications by students not of the Divinity School for rooms that shall remain unlet on that date, may be filed with the Bursar during the summer, but such applications must be accompanied in all cases by a written statement from the Dean of the Divinity School that the applicant is approved by him. Applicants who are not known to the Dean should present to him letters of introduction from some officer of the University, or other person qualified to give them.

REGULATIONS.

PETITIONS.

1. Every request from a student to the Administrative Board should be made in writing, and should be addressed to the Dean of the School.

REGISTRATION AND RESIDENCE.

2. Every student is required to present himself for registration not later than Thursday, the first day of the academic year, between 9 A.M. and 1 P.M., at a place announced on the bulletin boards of the School. He is further required to register not later than 12 M. on the first week-day after the Christmas recess and the first week-day after the April recess.

Special Scientific Students who are already members of the School, and candidates whose applications have been approved by the Board, will present themselves for registration on the same days and at the same place as students in regular standing.

3. Continuous residence at the University during term-time is required. No interruption of residence is permissible, except for satisfactory reasons stated to the Secretary (orally, if possible) before the student leaves Cambridge. The student who has been absent must immediately on his return report in person to the Secretary.

SCHOOL EXERCISES.

4. A student prevented by illness or other cause from attending School exercises for a day or more must send notice to the Secretary without delay. Immediately on his return to duty, he must make, at the Secretary's office, a specific statement of the cause of his absence; and, if his explanation is satisfactory, his absence will be excused.

5. A student who fails to give an instructor a theme, forensic, or other written exercises at the appointed time will get no credit for it, unless he satisfies the Secretary that the delay was caused by serious illness or other unavoidable hindrance.

6. A student who has neglected the work of any course may, with the approval of the Dean, be excluded from the course by the instructor.

ENROLMENT.

7. Every student is required to hand to the officer with whom he registers at the beginning of the academic year a list of his studies *for the whole year.* This list must be written on a card provided for the purpose, and must be signed by his Adviser.

At the same time and on the same card, every student is required to enroll himself in each of his studies which begin in the first half-year, whether prescribed or elective.

8. No student may, except by consent of the Administrative Board, enroll in more than six courses in one year, nor, in any term, in courses aggregating more than the rate of six courses for the year.

9. It is of the utmost importance that the student should have fully considered and decided upon his plan of study before the first day of the year, as changes, either additions to, or subtractions from the lists then handed in, are not allowed except for causes which could not have been foreseen. Changes may be made only with the approval of the Adviser and permission of the Dean, to whom application must be made in writing (on a blank form to be obtained at the office) with a full statement of reasons.

10. A student who has obtained leave to change his studies must enroll with the Secretary immediately upon receiving notice that the change has been permitted.

The exercises are held at the hours set down in the Announcement and at places to be announced on the bulletin boards.

11. A student who transfers from one programme to another must first obtain the consent of the adviser in the programme to which he transfers; and must make good all the studies of the new programme before being recommended for the degree therein.

EXTRA STUDIES.

12. A student who wishes, without assuming all the responsibilities of a regular study, to attend the instruction of any course, may do so on obtaining leave of the instructor; but no record will be kept of his attendance and he will receive no credit in the course.

ANTICIPATORY EXAMINATIONS.

13. Students who have anticipated studies in the Four Years' Programme in which they are registered, shall take such other studies as the Administrative Board may designate.

CONDITIONS AND DEFICIENCIES.

14. A candidate may be admitted with conditions in some of the admission subjects; but no candidate so admitted will be advanced to Third-Year standing in the School until he has made good such conditions to the satisfaction of the Administrative Board.

15. The exact number of conditions with which a candidate may be admitted cannot be named in advance; each case is considered on its merits.

16. No student in the Engineering programmes will be advanced to Second-Year standing until all his admission conditions in Mathematics are made good to the satisfaction of the Administrative Board.

PROMOTION.

17. In order to be promoted to a higher class at the end of a school year, a student must have attained in that year grade *C* or higher in at least one half of his required work, and must not have an aggregate deficiency of more than two courses.

18. A student who has failed in any course of prescribed study must make up the deficiency by taking the same course in some following year, and he is barred from dependent courses until such deficiency is made good.

19. A student who has failed of promotion under the operation of rule 17 will be placed on probation unless the Dean is satisfied that the failure to be promoted is not due to neglect.

20. To obtain credit in a course of study, or to count the course towards fulfilment of the requirements for a degree, the student must have attended both the mid-year and the final examinations. This rule applies to all students, including suspended students and students on leave of absence.

SPECIAL STUDENTS.

21. At the beginning of each year special students must submit their choice of studies for approval. They will be required to take each year four full courses selected from among the following: Courses in Mathematics, Engineering, Physics, Chemistry, Geology, Botany, or Zoölogy, and any courses in other departments which are prescribed in the several programmes of study for the degree of S.B.

22. At least one half of the work of each special student must be taken from the regular programme in which he registers.

23. Candidates who cannot otherwise show that they are competent to pursue subjects which are protected by entrance examinations, must pass satisfactory tests before entering these courses.

24. Exceptional cases may be submitted to the Administrative Board by petition.

EXAMINATIONS.

25. A student who has been absent from a mid-year examination, and has satisfied the Secretary that his absence was caused by serious illness or other unavoidable hindrance, is entitled to a second and last opportunity of passing the examination at some time during the period of the final examinations, provided he make written request for such examination before May 1.

26. A student who, having passed the mid-year examination in any course of study, has been absent from the final examination, and has satisfied the Secretary that his absence was caused by serious illness or other unavoidable hindrance, is entitled to a second and last opportunity of passing the examination at some time during the first fortnight of the ensuing academic year, provided he make written request for such examination before September 10.

27. No student is permitted to take any books or papers into an examination room except by express direction of the instructor. No communication is permitted between students in an examination room on any subject whatever.

28. If a student is tardy at an examination, he may not be admitted to it, and may be reported as absent.

GOOD ORDER.

29. No student shall lodge or board in any house disapproved by the Regent, or change his lodging without giving immediate notice to the Secretary.

30. No student shall refuse to give his name to an officer of the University. Every society of students shall give the Regent, at his request, a complete list of its officers and members.

31. No dramatic or musical society shall take part in an entertainment for money, or out of the limits of Old Cambridge without permission of the Faculty Committee on Dramatic and Musical Entertainments.

DISCIPLINE.

32. Neglect of School work and offences against law and order will be dealt with as the Faculty or the Administrative Board shall determine. Discipline may be enforced by Admonition, Probation, Suspension, Dismissal, or Expulsion.

Admonition includes a warning notice to parent or guardian.

Probation indicates serious danger of separation from the University. A student on probation is not allowed to compete for scholarships, prizes, or honors, or to take part — whether with students or with other persons — in any public theatrical or musical performance or in any public athletic contest; he cannot be restored to full standing without a special vote of the Administrative Board, and he cannot be recommended for a degree; he may be required to put himself under the direction of a private tutor approved by the Dean, or to report daily to an officer of the University, or to do both; and at any time, by vote of the Administrative Board, his probation may be closed and his connection with the University ended.

Suspension is temporary separation from the University, and may involve residence in a specified place and performance of specified tasks. A suspended student is not allowed to reside in Cambridge without the permission of the Administrative Board, or to visit Cambridge without the permission of the Dean, excepting at the period of the mid-year and final examinations. A suspended student is not allowed to take part in the public performances or games of any University association.

Dismissal closes a student's connection with the University, without necessarily precluding his return.

Expulsion is final separation from the University.

FOUR-YEAR PROGRAMMES OF COURSES.*

The courses included in the following twelve programmes are selected mainly from the Courses of Instruction provided by the Faculty of Arts and Sciences and are described in this Catalogue, pp. 154 to 245, under the headings which are here given in the parentheses.

The numbers and letters prefixed to the several courses are intended to be permanent, and no attempt is made to arrange them in regular or complete series.

The Roman numeral in parenthesis appended to each course indicates the examination group to which the course belongs.

Admission conditions in Mathematics must be removed by the end of the first year, and admission conditions in other subjects by the end of the second year.

Students receive credit for all advanced studies passed at the entrance examination. It will be found advantageous to prepare in the mathematics of the first year before entering the University.

Most of the subjects laid down in the programmes are necessarily arranged in sequence, and students are required to make satisfactory records at each stage of their progress in order to obtain further advancement. As there are many sequences of this kind, the student will do well to read, in the description of courses, the notes under the several subjects.

PROGRAMMES IN ENGINEERING.

General Statement.

The instruction in Civil, Mechanical, and Electrical Engineering provided by Harvard University is given under the immediate direction of a division of the Faculty of Arts and Sciences, known as the Division of Engineering.

The degrees in Engineering offered by the University are those of S.B. and S.M., the minimum courses of study for which, cover four undergraduate years and one graduate year, respectively.

The majority of the courses in Engineering may be counted towards the degree of A.B. as well as for that of S.B., and any of them may be taken as extra courses by candidates for the degree of A.B. Students in the Academic Department may accordingly elect courses in Engineering on much the same terms as in other subjects, and they may thus obtain a degree in Engineering, in addition to that of A.B., in five or six years after entering College.

Method of Instruction.

The Division directs its attention in undergraduate instruction primarily and constantly toward broad and persistent training in the fundamental principles. Specialties are taken up only to an extent sufficient to illustrate these principles, and to start the student toward a definite field of usefulness. The bulk of the work of specialization is left to be done after graduation, in the laboratory, office, field, or shop, when and where only it can be done to advantage.

The method of instruction is by lectures, assigned reading, and conferences, supplemented by recitations, blackboard drill, draughting, laboratory work, field work, and visits of inspection. The laboratory work includes practice with power and hand tools, testing machines, steam engines, dynamos, and other machines. Parts of summer vacations are utilized for the field work in surveying and railroad engineering, and also for the courses in shopwork.

Lectures are given before the Harvard Engineering Society, at intervals during the year, by engineers in active practice. These lectures are open to all students of Engineering.

The instruction in Engineering (except the summer work in Surveying and Railroad Engineering) is conducted in Cambridge in the closest relations with the other Cambridge activities of the University, and students of Engineering participate fully in the University life and atmosphere. This is believed to be as advantageous to them as to those looking toward other professions.

Buildings and Equipment.

Pierce Hall.

The new building now occupied by Engineering at Harvard is the successor of two small buildings. It was completed in time for use during the college year, 1901–02. The equipment will be increased from year to year, the policy of the University being to provide machinery only as it can be used profitably by the students.

The building is of brick, with limestone trimmings. The inside is not plastered, but is finished in brick, with oil paints in all rooms where machinery is used, and cold water paints in the lecture rooms, draughting rooms, and offices. There are accommodations for other departments in case it is found necessary to use the rooms for other lectures than those in Engineering.

The plan of the building is intended to give a maximum amount of light and air to every room. There are two large wings and a central structure, connected by stair halls containing lecture rooms, small draughting rooms, and offices. The wings measure 112 × 42 feet; the central part, 50 × 64 feet; and the stair halls, 46 × 46 feet. The outside dimensions are thus 226 × 112 feet, and the ground covered is 16,840 square feet, exclusive of the outside areas and the coal holes. There are four floors, a basement, and an attic; and the floor surfaces available for all purposes, including storage, are as follows:

Lecture rooms	11,495	square feet.
Laboratories	20,640	" "
Draughting rooms	11,938	" "
Professors' rooms	1,906	" "
Library	1,351	" "
Boiler and engine rooms	4,446	" "
Store rooms and basement	11,420	" "
Total floor space	63,196	square feet.

This floor space is exclusive of halls, stairs, entries, wash-rooms, and air ducts.

The draughting rooms are located on the top floor, the two large rooms being used mainly for the first-year elementary drawing, and the second-year instruction in descriptive geometry and graphical statics. The advanced work in designing is placed in three smaller rooms, where blueprints and books of reference can be kept.

The central structure contains four recitation rooms on the top floor, for sections in mathematics and other subjects where the number of students in a section is limited to thirty. On the second floor, in the centre, is a lecture room for one hundred and twenty students, and a library in which can be placed six or seven thousand volumes. The library contains now about six thousand volumes. The room is divided into three parts: one for periodicals, the second for bound volumes of periodicals and for text-books, and the third for the librarian's office. On the lower floor is a lecture room for three hundred students. There are eight other lecture rooms in the stair halls and wings, three of them capable of holding one hundred students each, and the others from twenty to thirty-five.

Laboratories.

The laboratories are confined mainly to the two wings. The south wing contains the machinery and apparatus for Electrical Engineering, and for testing materials of construction. The north wing contains all the other machines for research and experimental work. Several small rooms are provided for special work by the instructors and advanced students.

There are four main laboratories. *The hydraulic laboratory* is fitted with the necessary tanks and apparatus for experiments with nozzles, orifices, weirs, and turbines. It is intended to give students, especially those in civil engineering, as much experience with the measurement and flow of water as is possible, consistent with their course of studies.

The *laboratories* for *mechanical engineering* are distributed in a number of rooms, in order to obtain facilities for conducting a great variety of tests at the same time. The rooms are fitted with gas engines, hot-air engines, steam engines, pumps, and in general such small machinery as would be found in a power station. There is, besides, a large amount of machinery for general problems connected with applied mechanics, such as the efficiency of belts, ropes, chains, and gears; the frictional resistance of surfaces; and the use of transmission dynometers. Several rooms are given up to the calibration and investigation of steam gauges, indicators, and other instruments usually used in engine and boiler tests. Other heat problems, such as conduction, radiation, and a limited amount of chemical investigation may be undertaken in the laboratory.

The *electrical laboratories* have been recently supplied with a large number of dynamos and motors, for continuous and alternating currents. The machines are usually arranged in pairs on the heavy benches, each pair consisting of a dynamo and a motor connected by a belt. There are eight rooms given up to the various types of electrical machinery and apparatus, and undergraduate or graduate students have ample opportunity for carrying on extended research.

One large room is fitted with machines for testing the ordinary materials used in engineering work.

In addition to the above, the boiler room, two engine rooms, and the workshop are convertible into experimental laboratories, where students may run such power tests as seem advisable. The workshop is intended mainly for making new apparatus and for repairs, but it has also been used for the investigation of cutting tools and the power to drive machine tools.

It is not intended here to give a list of the machines used by the Department for its instruction, but simply to indicate the kind of work which the student is expected to do. The equipment is an increasing one, and will grow from year to year as there is demand for additional instruction.

The Engineering Camp.

The Harvard Engineering Camp, where the instruction in Plane and Geodetic Surveying and in Railroad Engineering is given, is located on the eastern shore of Squam Lake in New Hampshire. The camp tract covers an area of nearly four hundred acres, consisting of wooded and open land, and including several small hills and nearly two miles of lake shore. The buildings are situated among the trees on the margin of the lake and command a fine prospect of the lake. A grove near by furnishes a most suitable tenting ground.

The buildings contain a large living room, dining room, and kitchen; rooms for lectures and drafting; and a dormitory with sleeping rooms for thirty or forty students. Other students are assigned to tents. The tents are provided with floors and accommodate three or four students in each one. Should a student desire to bring his own tent, he may do so.

The Camp may be reached by wagon road from Centre Harbor — the nearest town — which is six miles away, on Lake Winnepesaukee. The most convenient route, however, is via Ashland, N. H., on the line of the Boston and Maine Railroad, and thence by boat through the Squam Lakes — a distance of about eight miles. The Camp launch makes daily trips to Ashland, for mail and supplies. The Post-office address is Ashland, N. H. Telegrams should be sent via Centre Harbor, N. H., in every case, and not via Ashland. To insure their quick delivery messages should be prepaid. The Camp is connected through the Centre Harbor Exchange by long distance telephone.

Students should provide themselves with the text-books indicated on pages 182, 183, under Courses 4*a*, 4*c*, and 4*d*, two field note-books, and the following drafting instruments: a pair of compasses with needle, pencil, and pen points, a pair of spacers, right-line and contour pens, a T-square, 45° and 60°–30° triangles, and a triangular engineer's scale with 10, 20, 30, 40, 50, and 60 divisons to the inch, a pocket magnifying glass, a drawing board, ink, pencils, and paper. All of the above articles, including text-books, may be purchased at the Camp store. The store also handles the mail, express and laundry, and keeps in stock, stationery, lunch-boxes, medicines, and other small wares.

Students will need also towels, hob-nailed boots, a white duck hat, canvas leggins, two flannel shirts, *and two suits of clothing suitable for work.* A change is essential in cold, rainy weather. Canvas trousers and jackets are the most economical. Ordinary old clothes will answer. A rubber coat, rubber blanket and sweater are useful. For the cold nights plenty of bed clothing is very necessary. As the Camp does not supply mattresses, at least two pairs of army blankets or an equal amount of other bedding will be needed. The student should take these supplies with him.

Musical instruments of any kind, a fishing-rod, a base-ball outfit and especially a light row-boat or canoe will be found pleasant additions to camp life. Canoes and row-boats, if carefully crated, may be sent by freight both safely and cheaply. If not crated, they should be sent only by express. To be at the Camp in time for use upon arrival, express packages should be sent four days, and bulky freight ten days, in advance.

The School provides the students with a place to sleep, either in a tent or in a house, with a woven wire cot, tin basins, tin cups, lanterns, hatchets, pails, and canteens.

The daily programme is as follows : —

WEEK-DAYS EXCEPT SATURDAYS.

Rising-horn	6 A.M.
Breakfast	6.25 A.M.
Lectures and Problems	7 A.M.–4 P.M.

SATURDAYS, 7 A.M.—12 M.

On Thursday, June 15th, 1905 — at an hour and in a place to be designated later — the students will assemble in Cambridge for the purpose of receiving final instructions and to deposit the tuition fee and board money. On Saturday, June 17th, they will proceed by special transportation via the Boston and Maine Railroad for Ashland, N.H.; thence by boat across the Squam Lakes to the Camp, arriving in the early afternoon. Those students who may have entrance, final, or make-up examinations after June 17th will take them at the Camp.

The charges for the courses given at the Camp during the summer of 1905 will be as follows : —

For members of the University who have paid a full year's tuition for the College year 1904–05.

Engineering	*4a*, board and lodging	$45,	laboratory fee $10
"	*4d*, " " "	22.50,	" " 5
"	*4c*, " " "	15,	" " 5
"	*4a*, *4d*, *4c* combined, board and lodging,	82.50,	" " 20
"	*5b* or *5d*. Fee for each course, including board and lodging, $40. For *5b* and *5d* combined, $80.		

By any qualified applicants who are not members of the University or by members who have paid less than full tuition for 1904–05, any of the above courses may be taken upon payment of a tuition fee of $20 for *4a*, and $10 each for *4d* and *4c*, in addition to the above charges. Each student must pay for repairs upon any instrument injured during the time it is assigned to his use.

Elementary courses in Mathematics and Mechanics will be repeated at the Camp every summer in case there are students enough to justify it. Only one course can be taken at a time.

Shopwork.

The Shopwork courses are given in the building of the Cambridge Manual Training School by the teachers who are regularly employed there, but the courses are directed and supervised by a professor appointed for that purpose by Harvard University. The building is well equipped and the instruction is confined wholly to the summer.

CIVIL ENGINEERING.

The degree of Bachelor of Science in Civil Engineering will be conferred on students who complete this programme and pass the required examinations satisfactorily.†

First Year.

Algebra (Engineering 1*a*).
Mon., Wed., Fri., at 10 or 11. First half-year. (III)

Trigonometry (Engineering 1*b*).
I, *Tu., Th., Sat., at 10. First half-year.*
Or II, *Tu., Th., Sat., at 10. Second half-year.* (XI)

Analytic Geometry (Engineering 1*d*).
Mon., Wed., Fri., at 10 or 11. Second half-year. (III)

Mechanical Drawing (Engineering 3*a*).
Mon., at 1.30; draughting, I, *Mon., Fri., 1.30–4.30;* II, *Tu., Th., 1.30–4.30.* (VI)

Descriptive Inorganic Chemistry (Chemistry 1).
Mon., Fri., at 12; laboratory work, *Tu., Th., 1.30–3.30, or Wed., Fri., 2.30–4.30.* (V)

Rhetoric and English Composition (English *A*).
Divided into sections: I, *Mon., Wed., Fri., at 10;* II, *Mon., Wed., Fri., at 11;* III, *Mon., Wed., Fri., at 12;* IV, *Tu., Th., Sat., at 10;* V, *Tu., Th., Sat., at 11;* VI, *Tu., Th., Sat., at 12.* (XVI)

German or French. One full course in addition to the admission requirements, so chosen as not to conflict with other prescribed courses.

Elementary Physics (Physics *B*).
Wed., at 12; laboratory work, *one two-hour exercise a week*, and recitations or conferences, *one hour a week.* For those only who did not present Physics for admission. (I and V)

Surveying (Engineering 4*a*).‡
Six weeks in the summer.

Geodetic Surveying (Engineering 4*c*).‡
Two weeks in the summer.

Railroad Engineering (Engineering 4*d*).‡
Three weeks in the summer.

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† Students of Civil Engineering are advised to take in addition to this programme the Shopwork Courses, Engineering 10*a*, 10*b*, 10*c* and 10*e*.

‡ Engineering 4*a*, 4*c* and 4*d* are preferably taken at the close of the First Year, but may be taken during a subsequent summer with the consent of the Chairman of the Division.

SECOND YEAR.

Differential and Integral Calculus (Engineering 1*c*).
Tu., Th., Sat., at 11. (XII)

Descriptive Geometry (Engineering 3*b*).
Mon., Wed., Fri., 11–1. Second half-year. (IV)

Mechanism (Engineering 3*d*).
Wed., Fri., at 10; draughting, *Wed., Fri., 11–1. First half-year.* (III)

Elementary Statics (Engineering 5*b*).
Tu., Th., Sat., 9–11. First half-year. (X)

Elementary Kinematics and Kinetics and Problems in Statics (Engineering 5*e*).
Tu., Th., Sat., 9–11. Second half-year. (X)

Steam Machinery, *introductory course* (Engineering 11*a*).
Mon., Wed., Fri., at 9, and one afternoon. Second half-year. (II)

Experimental Physics (Physics *C*).
Two lectures (one to the class as a whole, *Th., at 12*, and one to the class in five sections, *Mon., Tu., Wed., Th., and Fri., at 2*); three hours of laboratory work (seven sections: *Mon., Tu., Wed., Th., and Fri., 3–6; Mon. and Tu., 10-1*). (XIII)

Or, General Descriptive Physics (Physics 1).
Tu., Sat., at 12; and laboratory work, *one two-hour exercise a week.* (XIII)

English Composition (English *BC*).
Wed., at 1.30, and a second hour at the pleasure of the instructor. Half-course. (VI)

Geology 4 and 5 may be taken instead of during the fourth year.

THIRD YEAR.

Applied Mechanics (Engineering 5*a*).
Mon., Wed., Fri., at 11. (IV)

Hydraulics and Hydraulic Motors (Engineering 6*a*).
Mon., Wed., Fri., 9–11. Second half-year. (II)

Elements of Thermodynamics (Engineering 12*b*).
Mon., Wed., Fri., at 9. First half-year. (II)

Engineering Laboratory (Engineering 13*a*).
Tu., Th., at 10; laboratory work, *three hours a week.* (XI)

Machine Design (Engineering 14*a*).
Wed., 1.30–4.30; Sat., 10–1. Second half-year. (XII)

Generation, Transmission, and Utilization of Electrical Energy (Engineering 16*a*).
Tu., Th., Sat., at 9; laboratory work, *Tu., Th., or Fri., 1.30–4.30.* (X)

Metallurgy (Metallurgy 2).
Tu., Th., Sat., at 11. First half-year. (XII)

Geology 4 and 5 may be taken instead of during the fourth year.

FOURTH YEAR.

Road Making and Maintenance (Engineering 4*e*).
Mon., Wed., at 11, and during April and May, Th., 1.30–4.30. Second half-year. (IV)

Railroad Engineering (Engineering 4*f*).
Tu., Th., Sat., at 9. Second half-year. (X)

Resistance of Materials (Engineering 5*c*).
Tu., Th., Sat., at 12. First half-year. (XIII)

Water Supply and Sanitary Engineering (Engineering 6*c*).
Mon., Wed., Fri., at 10, and three hours of laboratory work. First half-year. (III)

Canals, Rivers, and Harbors (Engineering 6*d*).
Tu., Th., Sat., at 9; laboratory work, *four hours a week. First half-year.* (X)

Bridges and Buildings (Engineering 7*a*).
Mon., Wed., Fri., 1.30–4.30. (VI)

Building Stones, Masonry, and Foundations (Engineering 8*a*).
Tu., Th., Sat., at 11. Second half-year. (XII)

Engineering Conference (Engineering 21).
Two hours a week during the second half-year, usually in the evening.

Contracts and Specifications (Engineering 22).
Th., at 12. Second half-year. (XIII)

Elementary Geology (Geology 4).
Mon., Wed., Fri., at 12. First half-year. (V)

Elementary Field and Laboratory Geology (Geology 5).
Wed., and usually Fri., at 12.
In February and March: laboratory work, *two hours, twice a week,* in sections: Section A, *Tu., Th., 10–12;* or B, *Tu., Th., 1.30–3.30;* or C, *Wed., Fri., 1.30–3.30. In April and May:* field work, *Th. or Fri., one half-day a week,* and laboratory or field work, *Tu. or Wed. Second half-year.* (V)

MECHANICAL ENGINEERING.

The degree of Bachelor of Science in Mechanical Engineering will be conferred on students who complete this programme and pass the required examinations satisfactorily.*

First Year.

Algebra (Engineering 1*a*).
Mon., Wed., Fri., at 10 or 11. First half-year. (III)

Trigonometry (Engineering 1*b*).
I, *Tu., Th., Sat., at 10. First half-year.*
Or II, *Tu., Th., Sat., at 10. Second half-year.* (XI)

Analytic Geometry (Engineering 1*d*).
Mon., Wed., Fri., at 10 or 11. Second half-year. (III)

Mechanical Drawing (Engineering 3*a*).
Mon., at 1.30; draughting, I, *Mon., Fri., 1.30–4.30;* II, *Tu., Th., 1.30–4.30.* (VI)

Descriptive Inorganic Chemistry (Chemistry 1).
Mon., Fri., at 12; laboratory work, *Tu., Th., 1.30–3.30, or Wed., Fri., 2.30–4.30.* (V)

Rhetoric and English Composition (English *A*).
Divided into sections: I, *Mon., Wed., Fri., at 10;* II, *Mon., Wed., Fri., at 11;* III, *Mon., Wed., Fri., at 12;* IV, *Tu., Th., Sat., at 10;* V, *Tu., Th., Sat., at 11;* VI, *Tu., Th., Sat., at 12.* (XVI)

German or French. One full course in addition to the admission requirements, so chosen as not to conflict with other prescribed courses.

Elementary Physics (Physics *B*).
Wed., at 12; laboratory work, *one two-hour exercise a week*, and recitations or conferences, *one hour a week.* For those only who did not present Physics for admission. (I and V)

Shopwork. Chipping, Filing and Fitting (Engineering 10*a*).†
Ninety hours in summer.

Shopwork. Blacksmithing (Engineering 10*b*).†
Ninety hours in summer.

Shopwork. Pattern Making and Foundry Practice (Engineering 10*c*).†
Ninety hours in summer.

Shopwork. Machine-Shop Practice (Engineering 10*e*).†
Ninety hours in summer.

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* Students of Mechanical Engineering are advised to take in addition to this programme at least Course 4*a* of the Surveying Courses, Engineering 4*a*, 4*c* and 4*d*.

† Engineering 10*a*, 10*b*, 10*c* and 10*e* are preferably taken at the close of the First Year, but may be taken during a subsequent summer with the consent of the Chairman of the Division.

SECOND YEAR.

Differential and Integral Calculus (Engineering 1*c*).
Tu., Th., Sat., at 11. (XII)

Descriptive Geometry (Engineering 3*b*).
Mon., Wed., Fri., 11–1. Second half-year. (IV)

Mechanism (Engineering 3*d*).
Wed., Fri., at 10; draughting, *Wed., Fri., 11–1. First half-year.* (III)

Elementary Statics (Engineering 5*b*).
Tu., Th., Sat., 9–11. First half-year. (X)

Elementary Kinematics and Kinetics and Problems in Statics (Engineering 5*e*).
Tu., Th., Sat., 9–11. Second half-year. (X)

Steam Machinery, *introductory course* (Engineering 11*a*).
Mon., Wed., Fri., at 9, and one afternoon. Second half-year. (II)

Experimental Physics (Physics *C*).
Two lectures (one to the class as a whole, *Th., at 12*, and one to the class in five sections, *Mon., Tu., Wed., Th., and Fri., at 2*); three hours of laboratory work (seven sections: *Mon., Tu., Wed., Th., and Fri., 3–6; Mon. and Tu., 10–1*). (XIII)

Or, General Descriptive Physics (Physics 1).
Tu., Sat., at 12; and laboratory work, *one two-hour exercise a week.* (XIII)

English Composition (English *BC*).
Wed., at 1.30, and a second hour at the pleasure of the instructor. Half-course. (VI)

THIRD YEAR.

Applied Mechanics (Engineering 5*a*).
Mon., Wed., Fri., at 11. (IV)

Hydraulics and Hydraulic Motors (Engineering 6*a*).
Mon., Wed., Fri., 9–11. Second half-year. (II)

Elements of Thermodynamics (Engineering 12*b*).
Mon., Wed., Fri., at 9. First half-year. (II)

Engineering Laboratory (Engineering 13*a*).
Tu., Th., at 10; laboratory work, *three hours a week.* (XI)

Machine Design (Engineering 14*a*).
Wed., 1.30–4.30; Sat., 10–1. Second half-year. (XII)

Generation, Transmission, and Utilization of Electrical Energy (Engineering 16*a*).
Tu., Th., Sat., at 9; laboratory work, *Tu., Th., or Fri., 1.30–4.30.* (X)

Metallurgy (Metallurgy 2).
Tu., Th., Sat., at 11; and laboratory work, *one afternoon a week (Tu. or Th.). First half-year.* (XII)

FOURTH YEAR.

Resistance of Materials (Engineering 5*c*).
Tu., Th., Sat., at 12. First half-year. (XIII)

Efficiency and Economics of Heat Engines (Engineering 12*a*).
Mon., Wed., Fri., at 10. First half-year. (III)

Heating and Ventilation (Engineering 12*c*).
Mon., Wed., Fri., at 12. First half-year. (V)

Engineering Laboratory (Engineering 13*b*).
Lecture, *Mon., at 11;* laboratory work, *nine hours a week.* (IV)

Machine Design (Engineering 14*b*).
Twelve hours a week, Tu., Th., Sat., 9–1.

Engineering Conference (Engineering 21).
Two hours a week during the second half-year, usually in the evening.

Contracts and Specifications (Engineering 22).
Th., at 12. Second half-year. (XIII)

ELECTRICAL ENGINEERING.

The degree of Bachelor of Science in Electrical Engineering will be conferred on students who complete this programme and pass the required examinations satisfactorily.*

FIRST YEAR.

Algebra (Engineering 1*a*).
Mon., Wed., Fri., at 10 or 11. First half-year. (III)

Trigonometry (Engineering 1*b*).
I, *Tu., Th., Sat., at 10. First half-year.*
Or, II, *Tu., Th., Sat., at 10. Second half-year.* (XI)

Analytic Geometry (Engineering 1*d*).
Mon., Wed., Fri., at 10 or 11. Second half-year. (III)

Mechanical Drawing (Engineering 3*a*).
Mon., at 1.30; draughting, I, *Mon., Fri., 1.30–4.30;* II, *Tu., Th., 1.30–4.30.* (VI)

Descriptive Inorganic Chemistry (Chemistry 1).
Mon., Fri., at 12; laboratory work, *Tu., Th., 1.30–3.30*, or *Wed., Fri., 2.30–4.30.* (V)

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* Students of Electrical Engineering are advised to take in addition to this programme at least Course 4*a* of the Surveying courses, Engineering 4*a*, 4*c*, and 4*d*.

Rhetoric and English Composition (English *A*).

Divided into sections: I, *Mon., Wed., Fri., at 10;* II, *Mon., Wed., Fri., at 11;* III, *Mon., Wed., Fri., at 12;* IV, *Tu., Th., Sat., at 10;* V, *Tu., Th., Sat., at 11;* VI, *Tu., Th., Sat., at 12.* (XVI)

German or French. One full course in addition to the admission requirements, so chosen as not to conflict with other prescribed courses.

Elementary Physics (Physics *B*).

Wed., at 12; laboratory work, *one two-hour exercise a week*, and recitations or conferences, *one hour a week.* For those only who did not present Physics for admission. (I and V)

Shopwork. Chipping, Filing and Fitting (Engineering 10*a*).†

Ninety hours in summer.

Shopwork. Blacksmithing (Engineering 10*b*).†

Ninety hours in summer.

Shopwork. Pattern Making and Foundry Practice (Engineering 10*c*).†

Ninety hours in summer.

Shopwork. Machine Shop Practice (Engineering 10*e*).†

Ninety hours in summer.

SECOND YEAR.

Differential and Integral Calculus (Engineering 1*c*).

Tu., Th., Sat., at 11. (XII)

Descriptive Geometry (Engineering 3*b*).

Mon., Wed., Fri., 11–1. Second half-year. (IV)

Mechanism (Engineering 3*d*).

Wed., Fri., at 10; draughting, *Wed., Fri., 11–1. First half-year.* (III)

Elementary Statics (Engineering 5*b*).

Tu., Th., Sat., 9–11. First half-year. (X)

Elementary Kinematics and Kinetics and Problems in Statics (Engineering 5*e*).

Tu., Th., Sat., 9–11. Second half-year. (X)

Steam Machinery, *introductory course* (Engineering 11*a*).

Mon., Wed., Fri., at 9, and one afternoon. Second half-year. (II)

Experimental Physics (Physics *C*).

Two lectures (one to the class as a whole, *Th., at 12*, and one to the class in five sections, *Mon., Tu., Wed., Th., and Fri., at 2*); three hours of laboratory work (seven sections: *Mon., Tu., Wed., Th., and Fri., 3–6; Mon. and Tu., 10–1*). (XIII)

† Engineering 10*a*, 10*b*, 10*c* and 10*e* are preferably taken at the close of the First Year, but may be postponed till a subsequent summer with the consent of the Chairman of the Division.

Or, General Descriptive Physics (Physics 1).
Tu., *Sat.*, *at 12;* and laboratory work, *one two-hour exercise a week.* (XIII)

English Composition (English *BC*).
Wed., *at 1.30, and a second hour at the pleasure of the instructor. Half-course.* (VI)

THIRD YEAR.

Applied Mechanics (Engineering 5*a*).
Mon., *Wed.*, *Fri.*, *at 11.* (IV)

Hydraulics and Hydraulic Motors (Engineering 6*a*).
Mon., *Wed.*, *Fri.*, *9–11. Second half-year.* (II)

Elements of Thermodynamics (Engineering 12*b*).
Mon., *Wed.*, *Fri.*, *at 9. First half-year.* (II)

Engineering Laboratory (Engineering 13*a*).
Tu., *Th.*, *at 10;* laboratory work, *three hours a week.* (XI)

Direct-Current Dynamo-Electric Machinery (Engineering 16*c*).
Th., *Sat.*, *at 12;* laboratory work, *Mon.*, *1.30–4.30.* (XIII)

Electrostatics, Electrokinematics, and parts of Electromagnetism (Physics 3).
Tu., *at 12;* laboratory work, *six to eight hours a week.* (XIII)

FOURTH YEAR.

Alternating Currents and Alternating Current Machinery (Engineering 16*e*).
Tu., *Th.*, *Sat.*, *at 11;* laboratory work, *eight hours a week.* (XII)

Dynamo Design (Engineering 16*d*).
Tu., *Th.*, *2–5.* (XV)

Electrical Engineering Laboratory (Engineering 16*f*).
Tu., *at 9;* laboratory work, *six hours a week.* (X)

Electric Transmission and Distribution of Power (Engineering 17*a*).
Mon., *Fri.*, *at 9. First half-year.* (II)

Telegraphy and Telephony (Engineering 17*b*).
Mon., *Fri.*, *at 9. Second half-year.* (II)

Magnetism, Electromagnetism, and Electrodynamics (Physics 4).
Tu., *Th.*, *at 10*, and laboratory work. (XI)

Engineering Conference (Engineering 21).
Two hours a week during the second half-year, usually in the evening.

Contracts and Specifications (Engineering 22).
Th., *at 12. Second half-year.* (XIII)

MINING AND METALLURGY.

General Statement.

This programme is intended primarily to prepare students for the work of the graduate year, leading to the professional degrees of Mining Engineer and Metallurgical Engineer. At the same time it affords a broad training in applied science, and may advantageously be chosen by students who do not intend to engage in Mining or Metallurgical work. While the courses below may be completed in four years, the programme is a difficult one, and it is believed that many students, especially those who enter young and without anticipating some of the required work at admission, would do well to devote five years to undergraduate training.

The required work of the first year is identical with that of the four-year programmes in General Science, Geology, and Engineering, except that Spanish may be substituted for advanced French or German. The work of the second year does not differ materially from that in the various programmes in Engineering, except in the requirement of Chemistry and Geology. Thus the student is not bound to this programme of study after his first year of residence, and a change may be made even at the end of his second year, after more mature reflection and experience, without serious inconvenience.

Specialization in Mining and Metallurgy begins in the third year with introductory courses in Mining, Metallurgy, Fire Assaying, and Metallurgical Chemistry, for which the work of the preceding years has paved the way. The remaining time of the student is largely devoted to the allied subjects of Mineralogy and the Geology of Ore-deposits.

In the fourth year some specialization in either Mining or Metallurgy is required of the student. If he looks towards Metallurgy, his programme will include Metallography and the advanced course in Metallurgical Chemistry; while if he desires to specialize in Mining, it will include courses in Mining, Mining Plant, and Field Geology.

Throughout the course special importance is attached to the individual training of the student, and by a large amount of work in the laboratory to the development of his ability to deal with problems independently. Of the 3421 hours of required attendance during the four years, 1552 hours are in the lecture room, while 1869 hours are in the laboratory or field. These figures do not include the required work of the vacations.

Among the many opportunities afforded by the University and its activities, are some which have a direct bearing on the progress of the student along the line of his work. The Harvard Mining Club, a students' organization meeting fortnightly throughout the year, is frequently addressed by eminent engineers on subjects of mining and metallurgical interest. The Engineering Society sometimes presents similar opportunities.

Courses given in other Departments of the University are open to students of Mining and Metallurgy. Among such courses, one on the law of mines, given at intervals of about two years in the Harvard Law School, is of special importance.

Vacation Work.

A large amount of work is required during the vacations. These uninterrupted periods are especially useful for teaching Surveying and for bringing the student into touch with the practical side of his work.

During the summer vacation following the first year the student spends eleven weeks at Squam Lake, New Hampshire, in Plane, Railroad, and Geodetic Surveying.

During the third year, the April recess of one week is devoted to Geological Field-work in the carboniferous basin of Norfolk County, Massachusetts, a district unexcelled for the opportunities it affords for study of the stratigraphy of sedimentary rocks.

In the summer vacation following the third year six weeks are given to the study of mine plant and operations. The class, under the guidance and direction of an instructor, visits some mining district, and spends eight to ten hours a day in observing the working of mines, underground and on the surface. In past years the principal districts of Colorado and Utah, of Lake Superior, the Adirondacks, New Jersey, and Pennsylvania have been visited.

In 1904, the generosity of Mr. George Crocker will enable this work to be done more effectively than ever before. In coöperation with the mining departments of Yale, Columbia, and the Massachusetts Institute of Technology, a mine has been leased and equipped for teaching purposes. Besides instructors from the associated institutions, a force of skilled miners will be employed to teach drilling, blasting, timbering, track-laying, etc., in short the practical operations of mining that cannot be learned from lectures or books.

Buildings and Laboratory Equipment.

The work of the Department of Mining and Metallurgy is mainly carried on in the Rotch Building, which has been set apart by the Corporation for this purpose. This building contains a lecture room, a library, a reading and exhibition room and the following laboratories :—

The Laboratory of Metallurgical Chemistry.

The Laboratory of Metallurgical Chemistry occupies the west wing of the Rotch Building. The main room is sixty feet long by thirty feet wide and is twenty feet high. Adjoining are smaller rooms for the instructor, and for balances and storage.

The laboratory is ventilated by plenum and exhaust fans, the latter drawing air from the hoods. It contains forty-eight desks arranged in groups of eight. Each individual desk has a sink at one end and a hood at the other. The hoods are provided with hot plates and fixed steam and air baths. Each desk also has gas, compressed air, and suction for filtering.

At the end of the room are tables thirty feet long, fitted with lockers and supplied with gas and water. These tables are used for large or general apparatus, such as combustion furnaces, reductors, calorimeters, etc.

The equipment of the laboratory is designed for general metallurgical analysis, which demands much hood space, facilities for rapid evaporation and filtration, and good ventilation and light.

The Simpkins Ore-Dressing Laboratory.

The Simpkins Ore-Dressing Laboratory is eighty feet long by thirty feet wide and extends the full height of the building. This room is provided with modern machines of full size for the crushing, amalgamation, and concentration of ores. It contains a rock-breaker, a five stamp-battery with automatic feeder, a Frue vanner, a slime belt, a revolving buddle, belted and geared rolls, a Huntington mill, elevators, revolving screens, hydraulic classifiers, roughing and finishing jigs, amalgamating and clean-up pans, settler, etc.

The machines, which are driven by three fifteen-horse-power electric motors, are so arranged that they may be operated singly or in almost any desired combination for experimental work.

The Simpkins Assay Laboratory.

The Simpkins Assay Laboratory, in the the east wing of the Rotch Building, is forty feet long by twenty feet wide. It is equipped with nine two-muffle soft coal furnaces, a melting furnace, a power sample-grinder, and all the apparatus necessary for assaying. The laboratory contains twenty desks, each of which has its own gas, pulp-balance, fluxes and reagents.

The Simpkins Metallurgical Laboratory.

The Simpkins Metallurgical Laboratory, in the east wing of the Rotch Building, is fifty feet long by forty feet wide. It contains a blast furnace, a reverberatory roasting furnace, six gas-furnaces with accessories for the treatment of iron and steel, such as annealing, hardening, tempering, case hardening, malleablizing, etc., and for the melting and making of alloys; blowers, tempering baths, forges, Le Chatelier and Siemens pyrometers, a Riehlé testing machine (100,000 lbs.), a lathe, a power hack saw, electric furnaces, polishing machines, etc.

All heat work, the measurement of high temperatures, and the preparation of samples for analysis and of metallic specimens for optical investigation will be carried on in this room.

The Laboratory of Metallography.

The laboratory of metallography at present occupies the old Infirmary building on Holmes field, a short distance east of the Rotch Building. It contains microscopes and accessories for the examination of metals and other opaque objects, a Zeiss electric arc lamp with optical bench, Welsbach and acetylene lamps, cameras for photomicrography, a dark room, etc., and desks for eighteen students.

All heat treatment, pyrometric work, physical testing, polishing, etc., required ln metallographic work is carried on in the Simpkins Metallurgical Laboratory.

Recent Additions to Equipment.

The equipment of the Rotch Building has recently been enlarged by gifts from the Allis Chalmers Company, of a blast furnace with appurtenances, and a Bridgman mechanical sampler; from the Sullivan Machinery Company, of a rock drill and a hand-power diamond drill; from the J. George Leyner Engineering Works Company, of a Leyner drill; and from the Wilbraham Green Blower Company, of a Green blower.

Libraries.

The Scientific library of Professor Raphael Pumpelly, containing upwards of 3,000 bound volumes, is temporarily installed in the Rotch Building, and may be used by students under suitable restrictions. The Whitney library in the Museum and the Scientific School library in Pierce Hall contain a large number of books on Mining and Metallurgy. A small working collection of about 100 volumes, is placed in the reading-room of the Rotch Building, where also current numbers of the principal Mining and Metallurgical journals may be found.

First Year.

Algebra (Engineering 1*a*).
Mon., Wed., Fri., at 10 or 11. First half-year. (III)

Trigonometry (Engineering 1*b*).
I, *Tu., Th., Sat., at 10, first half-year:* or II, *Tu., Th., Sat., at 10, second half-year.* (XI)

Analytic Geometry (Engineering 1*d*).
Mon., Wed., Fri., at 10 or 11. Second half-year. (III)

Mechanical Drawing (Engineering 3*a*).

Lectures: *Mon., at 1.30.* Draughting, *six hours a week*: I, *Mon., Fri., 1.30–4.30;* II, *Tu., Th., 1.30–4.30.* (VI)

Elementary Physics (Physics *B*).

Wed., at 12; laboratory work, *one two-hour exercise a week*, and recitations or conferences, *one hour a week.* For those only who did not present Physics for admission. (I and V)

Descriptive Inorganic Chemistry (Chemistry 1).

Mon., Fri., at 12; laboratory work, *Tu., Th., 1.30–3.30, or Wed., Fri., 2.30–4.30.* (V)

Rhetoric and English Composition (English *A*).

Divided into sections. I, *Mon., Wed., Fri., at 10;* II, *Mon., Wed., Fri., at 11;* III, *Mon., Wed., Fri., at 12;* IV, *Tu., Th., Sat., at 10;* V, *Tu., Th., Sat., at 11;* VI, *Tu., Th., Sat., at 12.* (XVI)

One full course in a modern foreign language.

Surveying (Engineering 4*a*, 4*c*, and 4*d*).

Summer work, 11 *weeks.*

SECOND YEAR.

Differential and Integral Calculus (Engineering 1*c*).

Tu., Th., Sat., at 11. (XII)

Elementary Statics (Engineering 5*b*).

Tu., Th., Sat., 9–11. First half-year. (X)

Elementary Kinematics and Kinetics and Problems in Statics (Engineering 5*e*).

Tu., Th., Sat., 9–11. Second half-year. (X)

Steam Machinery (*introductory course*) (Engineering 11*a*).

Mon., Wed., Fri., at 9, and one afternoon. Second half-year. (II)

Experimental Physics (Physics *C*).

Two lectures (one to the class as a whole, *Th., at 12*, and one to the class in five sections, *Mon., Tu., Wed., Th., and Fri., at 2*); three hours of laboratory work (seven sections: *Mon., Tu., Wed., Th., and Fri., 3–6; Mon. and Tu., 10–1*). (XIII)

Or, General Descriptive Physics (Physics 1).

Tu., Sat., at 12; laboratory work, *one two-hour exercise a week.* (XIII)

Qualitative Analysis (Chemistry 3).

Mon., Wed., Fri., at 11. (IV)

Elementary Geology (Geology 4).

Mon., Wed., Fri., at 12. First half-year. (V)

Elementary Field and Laboratory Geology (Geology 5).

Wed., and usually Fri., at 12.

In February and March: laboratory work, *two hours, twice a week,* in sections: Section A, *Tu., Th., 10–12;* or B, *Tu., Th., 1.30–3.30;* or C, *Wed., Fri., 1.30–3.30. In April and May:* field-work, *Th. or Fri., one half-day a week,* and laboratory or field-work, *Tu. or Wed. Second half-year.* (V)

English Composition (English *BC*).

Wed., at 1.30, and a second hour at the pleasure of the instructor. Half-course. (VI)

THIRD YEAR.

Elements of Mining (Mining 1).

Tu., Th., Sat., at 9, and laboratory or field-work, *one afternoon every other week. Second half-year.* (X)

Metallurgical Chemistry (Metallurgy 6).

Mon., Wed., Fri., at 1.30. Second half-year. (VI)

General Metallurgy (Metallurgy 9).

Mon., Wed., Fri., at 9; and laboratory work, *one afternoon every other week (Mon. or Wed.). Second half-year.* (II)

Fire Assaying (Mining 10).

Mon., Wed., Fri., at 9; and laboratory work, *two afternoons a week (Mon., Tu., Wed., or Th.). First half-year.* (II)

The Study of Mining Operations (Mining 12).

Six weeks in the summer.

Mining Geology (Geology 10).

Mon., Wed., Fri., at 12. (V)

Mineralogy (Mineralogy 2).

Mon., Wed., Fri., at 10; laboratory work, *five hours a week,* to be chosen from the following periods: *Tu., 9–12; 1.30–4.30. Wed. and Fri., 11–1; 1.30–4.30.* (III)

Applied Mechanics (Engineering 5*a*).

Mon., Wed., Fri., at 11. (IV)

Generation, Transmission, and Utilization of Electrical Energy (Engineering 16*a*). *First half-year only.*

Tu., Th., Sat., at 9; laboratory work, *Tu., Th., or Fri., 1.30–4.30.* (X)

FOURTH YEAR.

Metallurgy of Iron and Steel (Metallurgy 2).

Tu. Th., Sat., at 11, and laboratory work *one afternoon a week (Tu. or Th.). First half-year.* **(XII)**

Metallurgy of Copper, Lead, Nickel, Zinc, and the Minor Metals (Metallurgy 3).
Tu., Th., Sat., at 11; and laboratory work *one afternoon a week. Second half-year.* (XII)

Ore Dressing, Concentration, and Milling (Mining 4).
Tu., Th., Sat., at 9, and laboratory work *two afternoons a week (Mon., Tu., Wed., or Th.).* (X)

Hydraulics and Hydraulic Motors (Engineering 6*a*).
Mon., Wed., Fri., 9–11. Second half-year. (II)

Elements of Thermodynamics (Engineering 12*b*).
Mon., Wed., Fri., at 9. First half-year. (II)

Engineering Laboratory (Engineering 13*a*).
Lectures, *Tu., Th., at 10;* laboratory work, *three hours a week.* (XI)

And either

Metal and Coal Mining (Mining 5).
Tu., Th., Sat., at 12, and a fourth hour at the pleasure of the instructor. First half-year. (XIII)

Mining Plant (Mining 11).
Tu., Th., Sat., at 12. Second half-year. (XIII)

Geological Surveying (Mining 28).
First half-year.

Or

Metallurgical Chemistry (Metallurgy 7).
Tu., Th., Sat., at 1.30. (XIV)

Metallography (Metallography 14).
Tu., Th., Sat., at 12, and laboratory work on *Tu., Th., from 2–5. Second half-year.* (XIII)

PROGRAMMES IN ARCHITECTURE AND LANDSCAPE ARCHITECTURE.

General Statement.

The instruction in Architecture and in Landscape Architecture provided by Harvard University, is given under the immediate direction of a department of the Faculty of Arts and Sciences known as the Department of Architecture which is a part of the Division of Fine Arts of that Faculty. The four years' professional curriculum in Architecture (as also that of Landscape Architecture) is one of the programmes of study of the Lawrence Scientific School, which, together with Harvard College and the Graduate School, is under the control of the Faculty of Arts and Sciences.

The courses in Architecture have been arranged primarily to meet the needs of students in the Lawrence Scientific School who are taking the technical four years' course and are candidates for the degree of S.B. in Architecture (see p. 125). All of these courses are open also to students in Harvard College who are fitted to profit by them; and the courses in the History of Architecture (1*a*, 1*b*, 1*c*), in Architectural Drawing (2*a*) (when taken together with 1*a*), in the Theory of Design (7), and Landscape Architecture 1 may be counted towards the degree of A.B.

Graduation both in Arts and in Science.

Students who wish to take the degree of Bachelor of Science in addition to the degree of Bachelor of Arts may register in the Lawrence Scientific School after their third year in Harvard College (or after the satisfactory completion of fourteen courses counting towards the degree of Bachelor of Arts). They may obtain the degree of Bachelor of Arts on the satisfactory completion of the required number of courses counting towards that degree, and the degree of Bachelor of Science after at least two years in the Scientific School.

If the College course is carefully planned with that end in view, it will be possible to graduate in architecture in two years after taking the Bachelor of Arts degree, *provided a sufficient number of the professional studies have been anticipated.* A student planning to accomplish this, must anticipate Architecture 2*a* and 4*a* before graduating from the College, as in any case four successive years must be devoted to architectural drawing and design. A bachelor of arts may in this way also take the degree of Master of Arts in architectural studies at the end of one year, and then go on to the degree of Bachelor of Science in Architecture in one year more. Of the subjects required in the curriculum of Architecture, the Languages, the Mathematics, most of the elective subjects named in the curriculum, and Courses 1*a*, 1*b*, 1*c*, 2*a*, 7 and 20 in Architecture and Landscape Architecture 1 may be counted towards a degree in arts.

Students in the College intending, after graduation, to take up the study of Architecture or Landscape Architecture professionally, are advised to arrange their College course in such a way as to provide an adequate foundation for their professional studies, and to anticipate some of the required subjects of the four-year programmes in these subjects. Besides taking the courses in Fine Arts, such students are recommended to study the History of Greece and Rome, the Middle Ages, and the Renaissance; and it is desirable that they should acquire the ability to read with some ease both French and German, as the best works on Architecture are in these languages. The Mathematics required in the four years' course in architecture might with great advantage be anticipated. The Professor of Architecture will be glad to advise students who intend to plan such a course.

The work of the architect requires not only a technical knowledge of building processes and familiarity with architectural form, its history and use, but it demands wide intellectual sympathy, cultivated taste, and trained imagination. Such training and cultivation can most readily be obtained — or the impulse leading to it can best be given — by a carefully arranged college course. Those who intend to pursue architecture as a profession are therefore strongly advised to take, if possible, a full college course before beginning their technical studies.

Candidacy for the American Institute of Architects.

The degree of Bachelor of Science in Architecture of Harvard University is accepted by the American Institute of Architects as admitting the holder to candidacy for membership in the Institute without the examination ordinarily required of such candidates.

New Building and Equipment.

The Department of Architecture, in which the courses in Landscape Architecture are given, now occupies the splendid building devoted exclusively to its use provided by the gift of Mr. and Mrs. Nelson Robinson of New York in memory of their son Nelson Robinson, Jr., of the class of 1900.

The building contains on the ground floor the following rooms: —

1. Running through two stories, a Hall of Casts in which are set up full size casts of important pieces of architecture. These include the orders of the Temple of Theseus at Athens, of the Mausoleum at Halikarnassus, and of the Temple of Vesta at Tivoli, the entablature of the Temple of Concord in Rome, several important Roman and Renaissance doorways (including that of the Temple of Hercules at Cori), the balcony and window of the Cancelleria palace in Rome, the fountain by Verrochio from the courtyard of the Palazzo Vecchio in Florence, the altar found at Ostia, besides statues, vases, cornices, and other smaller objects. A restoration of one corner of the Temple of Niké Apteros at Athens has been added.

During the past year these collections have been increased by a remarkably fine series of casts from Greek architectual detail, made in Athens for the department and including several casts from objects never hitherto reproduced; and also by the acquisition of a most interesting series of original fragments, chiefly marble, of Greek, Roman, and Italian Renaissance detail.

2. A lecture-room 50 × 30 feet (provided with two stereopticons in a gallery). In this room are hung a valuable collection of oriental embroideries, textiles, and prints, beside a number of copies from paintings of the great Italian masters, a few modern examples of drawing and etching, and one original painting by Van Oost. This collection, and a number of water-colors mainly architectural, in the freehand drawing room, is lent by Dr. Ross.

3. A room for freehand drawing. Here other casts chiefly of mediaeval architecture are set up. On the walls hang a large painting by Mr. Joseph Linden Smith of the Temple of Abou Simbel in Nubia, the gift of Mrs. David P. Kimball of Boston, and a collection of water-colors mainly of architectural subjects. Other drawings are kept in cases in this room. The collection of drawings is especially valuable, and includes, besides more modern works, original architectural drawings by such masters as J. M. W. Turner, Samuel Prout, J. D. Harding, David Cox, and S. J. Cotman.

4. An exhibition-room containing samples of building materials, models illustrating construction, etc.

5. A smaller lecture-room surrounded with blackboards used for blackboard drill.

6. A room for clay modelling in which casts principally of Greek, Roman, and Renaissance work are displayed. Here also for convenience are placed cases containing a small collection of pottery and bronze ware loaned by Dr. Ross as examples of design and color.

Besides these there are instructors' rooms and coat rooms.

On the second floor is the main drawing-room 140 × 30 feet, from which at one end opens a smaller drawing-room, and at the other the library, each 35 × 40 feet.

The drawing-room contains other important casts and drawings. It is open to students from 9 A.M. to 10 P.M., and instructors are usually present from 9 A.M. to 4 P.M.

The basement contains rooms for unpacking and mounting, photographic dark-rooms, store-rooms, toilet-room, etc.

From the gift of the same donors the collections of photographs, books, and drawings have been largely increased, and a valuable collection of about 8,000 lantern slides has been added, carefully selected to illustrate the lectures on Architecture and Landscape Architecture.

In addition to the collections of the Department of Architecture, those of the Fine Arts Department in the *Fogg Art Museum of the University, consisting of casts, photographs, diagrams, and drawings, and the casts

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* See page 267 and Architecture pamphlet.

and photographs of German work in the *Germanic Museum, and of Assyrian, Persian, and Roman work in the †Semitic Museum, are available and always open to students.

Architectural Library.

The Library of the Department of Architecture is open every week day during term time from 9 A.M. to 4.30 P.M., and three times a week from 7.30 to 9 P.M., except on Saturdays, when it closes at 1 o'clock. Large tables are provided for the convenient examination of the books and photographs, and for tracing. Students are encouraged to make the freest use of the books, photographs, and drawings. It is intended essentially as a reference library, and contains, besides a collection of over 10,000 photographs, all the works referred to in the courses in Architectural history and in the lectures on the Theory of Design; but most of the books have been chosen with regard to the work of the drawing-room, and especially to facilitate the practical work in design. The plates of many of the volumes have been taken from their bindings and mounted on separate cards like photographs, and are conveniently catalogued and arranged in cases. The Library now contains 657 bound volumes, besides 185 portfolios containing mounted plates.

The larger and more expensive books, mounted plates and photographs, are not to be removed from the building, but may be taken at any time for use in the drawing-room. The octavos and other volumes of moderate size may, on application to the assistant in the Library, be taken out after 4 o'clock, but must be returned before 10 o'clock on the following morning. On Saturday they may be taken out after 12 o'clock, to be returned before 10 o'clock on the following Monday morning. Such books, plates or photographs will be charged to the student borrowing them, and he will be held responsible for their safe return at the specified time. Any student who does not comply with these regulations will be deprived of the privilege of borrowing for such period as the Department may determine.

The University Library at Gore Hall contains a complete collection of books on Architecture and the Fine Arts numbering over 12,000 volumes. To facilitate the use of the large and valuable collection of works on Architecture and other Fine Arts in the University Library, a catalogue of these books is kept in the Department Library.

There is also a catalogue of the Architectural books in the Boston Public Library.

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* See page 268.

† See page 266.

ARCHITECTURE.

The instruction offered in the following programme is intended to afford the preliminary technical training required for the practice of Architecture. As all such school training must be supplemented by practical experience in an architect's office, students are advised during their period of study to devote a portion of their summer vacation to that work.

In grouping the courses it has been recognized that Architecture is essentially a Fine Art, the practice of which must be based on a thorough knowledge of Construction. Great stress has therefore been laid on continued practice in Design and Drawing and thorough instruction in the history and principles of the Fine Art of Architecture and the arts allied with it. Such knowledge as can be better and more rapidly acquired by actual office experience will only be touched upon in a general way in order to leave more time for subjects which can be adequately taught only in an architectural school.

The curriculum is so arranged that professional studies begin in the first-year and are continued through four years. In the first-year the History of Ancient Architecture is taken up in such a way as to give the student a familiarity with classic form which shall serve as a basis for the subsequent practice in original Design which continues through the whole of the following three years. The aim is to give students such a knowledge of the History of Architecture and of the growth and meaning of architectural forms as may enable them ultimately to use precedent not blindly, but intelligently and with some freedom. The History of Architecture (with practice in drawing its various forms) is continued through the second-year and completed in the third. Courses are included in the general history and principles of the Fine Arts which enable the student to understand the relation of Architecture to the other arts and the relation of the art of different periods to their social and political life. Without this knowledge the architect is not likely to use the forms of his art in an intelligent and scholarly manner.

The study of Design is pursued mainly by means of problems and criticisms. In addition to the regular staff of instructors, the Architects on the Committee appointed by the Board of Overseers takes part in the instruction in design. Each of these visiting Architects in turn has charge of a problem, discussing with the class the conditions when it is given out, and a week later criticising the preliminary sketches. The final drawings having been made by the students under the direction of the regular instructors, the final criticism is given by the visiting member of the Committee. This method of work has proved especially valuable and stimulating.

With regard to Construction, a thorough and broad general knowledge of principles and their application to modern work is insisted upon rather than a minute consideration of constructive details. So much of Mathematics is taught as is necessary to this knowledge and to the exigencies of actual office practice. The Mathematics required is completed in the first-year. In the second-year, Statics and Strength of Materials are taken up, and Building Construction in the third. In the fourth-year, lectures will be given on professional practice. Students who desire to pursue their study of construction further have opportunity to do so in courses provided by the Division of Engineering, if they are prepared in the necessary Mathematics. Students are advised to take the summer course in Surveying during some part of their course.

The latter half of the fourth-year is devoted to the preparation of a thesis. The subject of this thesis must be decided upon in consultation with the instructors of the department at the beginning of the year. It will consist of an original design for some architectural work, accompanied by a written essay considering the design, aesthetically and historically. The essay must also consider the constructive principles involved in the design, and give calculations concerning the more important structural parts.

Graduate Work in Architecture.

Facilities will be given for graduate work in Architecture, including both advanced work in design and construction, and special study of particular periods of architectural history for which the large collections of the department afford ample opportunity. Students who can do so are strongly advised to extend their period of school training by one or more years of graduate study. The four years that in this country have usually hitherto been allotted to such training, is a much shorter time than is given in the great schools of art in Europe, or than might with advantage be devoted to academic training in architecture.

Graduates of other architectural schools or experienced draughtsmen who give evidence of their fitness to profit by them, will be also admitted to these advanced courses. Advanced courses in construction given by the Division of Engineering are also open to such students so far as they are prepared to pursue them with advantage.

The following schedule sets forth the studies required of those persons who are candidates for the degree of S.B. in Architecture. By anticipating any of these subjects at the admission examination or by passing the equivalent course in the Summer School, students gain additional time to devote to the strictly professional studies. The programme is arranged to be completed in four years, but students are advised to take five years unless they have anticipated at least two of the following subjects: The prescribed English, Advanced French, Advanced German, Elementary Physics, Architectural Drawing.

Candidates for admission who intend to pursue this course should therefore if possible include the above subjects among those offered for admission. They are advised to offer also both the History of Greece and Rome and the History of the United States and England, as well as Freehand Drawing which is especially important. In Freehand Drawing, ability to represent simple objects accurately by means of firm lines will be expected. Accuracy of delineation, correctness of proportion, and good quality of line are desired rather than any attempt at elaboration. A pamphlet may be had on application, describing the requirements for the admission examination in Freehand and Architectural Drawing. The Architectural Drawing of the admission requirements, with the course on Projections which necessarily precedes it, is substantially equivalent to the course Architecture 2*a* of the first-year in the Programme in Architecture.

Students will receive credit for all advanced studies passed at the admission examinations. It will be found advantageous to have a thorough preparation in both French and German before entering.

Students who complete the following programme of studies and present a satisfactory thesis will receive the degree of S.B. in Architecture.

First Year.

Technical and Historical Development of the Ancient Styles (Architecture 1*a*).
Mon., Wed., Fri., at 12, and additional hours for drawing. (V)

Elementary Architectural Drawing. — Elements of Architectural Form. — The Orders (Architecture 2*a*).
Tu., Th., 2.30–4.30, and at least ten other hours. (XV)

Principles of Delineation, Color, and Chiaroscuro (Fine Arts 1).
Mon., Wed., Fri., at 2.30, and additional hours for drawing. (VII)

Trigonometry (Engineering 1*b*).
I, *Tu., Th., Sat., at 10, first half-year; or* II, *Tu., Th., Sat., at 10, second half-year.* (XI)

Rhetoric and English Composition (English *A*).
Divided into sections: I, *Mon., Wed., Fri., at 10;* II, *Mon., Wed., Fri., at 11;* III, *Mon., Wed., Fri., at 12;* IV, *Tu., Th., Sat., at 10;* V, *Tu., Th., Sat., at 11;* VI, *Tu., Th., Sat., at 12.* (XVI)

German *or* French.¶
One full course.

*Elementary Physics (Physics *B*).
Wed., at 12; laboratory work, *one two-hour exercise a week;* recitations or conferences, *one hour a week.* (I and V)

Second Year.

†Technical and Historical Development of the Mediaeval Styles (Architecture 1*b*).
Mon., Wed., Fri., at 10. (III)

Or †Technical and Historical Development of Renaissance and Modern Architecture (Architecture 1*c*).
Mon., Wed., Fri., at 10. (III)

Freehand Drawing (Architecture 3*a*).
Six hours a week: usually Mon., Wed., Fri., 11–1.

Elementary Architectural Design (Architecture 4*a*).
Mon., 2–4.30, and at least twelve other hours a week. (VII)

Descriptive Geometry. — Stereotomy; Shades, Shadows, and Perspective (Architecture 2*b*).
Lectures and draughting, *Tu., Th., Sat., 11–1.* (XII and XIII)

Elementary Statics (Engineering 5*b*).
Tu., Th., Sat., 9–11. First half-year. (X)

Resistance of Materials (Engineering 5*d*).
Tu., Th., Sat., 9–11. Second half-year. (X)

‡English Composition (English *BC*).
Wed., at 1.30, and a second hour at the pleasure of the instructor. Half-course. (VI)

German *or* French.¶
One full course.

Third Year.

†Technical and Historical Development of the Mediaeval Styles (Architecture 1*b*).
Mon., Wed., Fri., at 10. (III)

Or †Technical and Historical Development of Renaissance and Modern Architecture (Architecture 1*c*).
Mon., Wed., Fri., at 10. (III)

¶ Students who have passed both Advanced French and Advanced German in the admission examinations are exempted from further study of these languages.

* For those who do not present Physics for admission.

† These courses are given in alternate years.

‡ Required of those students only who pass in English *A* with a grade lower than *C*.

Freehand Drawing, second course (Architecture 3*b*).
Six hours a week: usually Tu., Th., Sat., 9–11.

Architectural Design, second course (Architecture 4*b*).
Tu., 2–4.30, and at least sixteen other hours a week. (XV)

Building Construction. — Carpentry. Lectures and drawing (Architecture 5).
Mon., at 3.30, and two other hours. First half-year. (VIII)

Theory of Design (Architecture 7*a*).
Mon., Wed., Fri., 1.30–3.30. (VI)

Building Stones, Masonry and Foundations (Engineering 8*a*).
Tu., Th., Sat., at 11. Second half-year. (XII)

FOURTH YEAR.

Freehand Drawing, third course (Architecture 3*c*).
Six hours a week required, usually Tu., Th., Sat., 11–1.

Architectural Design, third course (Architecture 4*c*).

Modelling (Architecture 6).
Th., 1.30–4.30. Half-course.

Contracts and Specifications (Engineering 22).
Th., at 12. Second half-year. (XIII)

And the equivalent of two courses selected from the following: —

*Principles of Design in Architecture, Sculpture, and Painting (Fine Arts 2).
Mon., Wed., Fri., at 3.30. (VIII)

History of Ancient Art (Fine Arts 3).
Tu., Th., Sat., at 9. (X)

*The Fine Arts of the Middle Ages and the Renaissance (Fine Arts 4).
Mon., Wed., Fri., at 9. (II)

†The Private Life of the Romans (Latin 10).
Tu., Th., and (at the pleasure of the instructor) Sat., at 12. (XIII)

†The Life of the Ancient Athenians (Greek 10).
Tu., Th., and (at the pleasure of the instructor) Sat., at 12. (XIII)

Principles of Landscape Architecture (Landscape Architecture 1).
Mon., Wed., Fri., at 9. (II)

[Aesthetics (Philosophy 10).
Mon., Wed., Fri., at 2.30. Second half-year.]

Bridges and Buildings (Engineering 7*a*).
Mon., Wed., Fri., at 1.30–4.30. (VI)

* Fine Arts 2 and Fine Arts 4 cannot both be counted towards a degree by the same student.

† These courses are given in alternate years.

LANDSCAPE ARCHITECTURE.

The object of the courses of study in Landscape Architecture, is to provide instruction in the elements of technical knowledge, and training in the application of principles of design, which together form the proper basis for the professional practice of Landscape Architecture.

With the best technical training, the professional success of a Landscape Architect must depend largely upon his ability to understand the wide range of purposes and ideals which he is sure to find among his clients, and in no way can this ability be fostered more effectively than by the broadening influence of a college education.

It is therefore urgently recommended to anyone who would fit himself for the practice of landscape architecture that he take a four years' college course of general studies, devoting about half of his time, however, to subjects of direct interest to landscape architects. Such courses in Harvard College as are particularly advised to this end are the following: Principles of Design in Architecture, Sculpture, and Painting (Fine Arts 2); Ancient Architecture and Renaissance Architecture (Architecture 1*a* and 1*c*); Theory of Design (Architecture 7); Principles of Landscape Architecture (Landscape Architecture 1); Elementary Botany (Botany 1); Experimental Physics (Physics *C*); Physiography (Geology *A*); Elementary Geology (Geology 4 and 5). A substantially equal amount of study should be devoted to distinctly different fields of knowledge determined by the needs and interests of the individual.

In addition to these studies which form reasonable parts of a general college education, the undergraduate who looks forward to becoming a landscape architect ought to take the summer course in topographical and railroad surveying at the Harvard Camp, or its equivalent, and should become well acquainted with the common trees and shrubs. If he has had the opportunity of getting a first-hand acquaintance with the soil and plants through the common work of practical farming or some kindred occupation, he will find it, in the long run, helpful to a remarkable degree.

While the above outline indicates the subject matters of study with which a student of landscape architecture should be familiar when he begins his professional work, it is of still more importance that he should have acquired a facility in the understanding and use of those means of expression by which his further study must be conducted. Any intelligent student will appreciate the fact that he must have a good command of English, since an essential part of a landscape architect's duties must be to explain clearly and convincingly to others the reasons for his advice to them. In addition it is very desirable that the student should be able to use French and German books with tolerable facility.

What is not so generally realized by students, in advance, is the vital importance to the landscape architect of facility in graphic expression. He must be able readily to draw a simple, straight-forward and accurate representation of the forms which he sees or wishes to describe, whether by sketches, plan or section; and the alphabet of this graphic language, which he must use all his life, ought to be learned early and practised constantly.

Training in freehand drawing may be obtained in college in connection with the courses in Architecture and the other Fine Arts, especially in the freehand drawing courses, Architecture 3*a*, 3*b*, and 3*c*, and by voluntary practice in connection with the countless occasions in every student's work where diagrams and sketches can be used to illustrate and explain. In addition to this, projection drawing should be mastered, and this can best be studied from the standpoint of architectural draughting as is done in Architecture 2*a* and 2*b*. While these courses are too technical to be counted towards an A.B. degree, they are too elementary to be regarded as post-graduate professional work, and should, if possible, be taken before the end of the college course as "additional" studies.

The foundation then, which is advised as a preliminary to the professional training of a landscape architect, for all those who can possibly command it, is an A.B. degree or its equivalent; a good grounding in the principles of design in art, and an intelligent acquaintance with the forms of classic and renaissance architecture and their use by architects; a sound elementary knowledge of physics, of geology and of botany; some experience in topographical surveying; a familiarity with the common trees and shrubs of New England; and, finally, a respectable proficiency in English composition and in accurate freehand and architectural drawing. This foundation can be obtained by a good student in the course of four years at Harvard College by a moderate amount of diligent special work outside of that directed to the A.B. degree, and without impairing the breadth of intellectual and social interests which it is the main purpose of a college course to awaken. This implies that the student should take each year one course in addition to the college requirements, thus completing Architecture 2*a*, 2*b*, 3*a*, and 3*b*, or their equivalents, that he should take Engineering 4*a* and 4*d* during one of the summers, and that he should interest himself in the study of trees and shrubs especially during the leisure of the other summers. One who is unable to accomplish this amount of work successfully during four years is advised to extend the time of preparation to five, in which time he should be able to advance himself still further along the lines indicated, possibly adding practice in elementary architectural design, to be obtained in Architecture 4*a*.

On the basis of such preparation a student can obtain a good professional equipment by three or even by two years devoted solidly to technical work. No definite programme is here laid down for such a post-graduate course, because it can best be fitted to the needs of the individual; but it would always include two years of practice in general Landscape Design and details of construction (Landscape Architecture 2 and 3), continued study of plants and Planting Design (Horticulture 1*a*, 1*c*, 1*d*, 2 and 3), Elementary Architectural Design if not already studied (Architecture 4*a*), Road Construction (Engineering 4*e*), Water Supply and Sanitary Engineering (Engineering 6*c*), Masonry and Foundations (Engineering 8*a*), Contracts and Specifications (Engineering 22), and as much additional work in Engineering, Horticulture, and general Landscape Design as time and capacity permit.

It should further be said that while the training above discussed should make a student a useful assistant to a landscape architect, it is not expected to turn him out competent to practice, and should be followed by at least two or three years of practical experience in the employ of an established landscape architect, and by travel for the study of professional subjects in this country and in Europe.

For those who feel unable, through lack of means or ambition, to devote more than four years after their graduation from the high school to academic training for the profession, the four years' programme which follows is offered. In it, as in the programme just outlined, the attempt is made to give students, as a prerequisite to intelligent and successful design, a working knowledge of the materials which are required in the execution of plans, and a familiarity with the means by which they may be utilized.

After a course in elementary Botany in Cambridge, particular attention is given at the Bussey Institution, in courses in Horticulture, and planting Design, to the study of plants both as individuals and as elements of landscape.

All the other technical instruction, which in many respects is similar to that required for engineers and architects, is given at Cambridge, with the exception of the summer field course in Surveying. This course is intended to insure the necessary familiarity with the making and interpreting of topographical maps. For the general training of the eye and the hand, and as a necessary preliminary and accompaniment to the courses in Design, much attention is given to both mechanical and freehand drawing. Finally, the other engineering requirements of the profession are treated in the courses on Trigonometry, Road Building and Maintenance, Water Supply and Sanitary Engineering, Masonry and Foundations, and Contracts and Specifications. The three courses in Geology and Geography are included in the programme in order to give a useful, practical understanding of geological structure and to open the way to a better comprehension of landscape forms and a more intelligent sympathy in dealing with them.

Study of the history and principles of Design is begun in the first year, and in the second year some elementary training is given in their application to architectural subjects, while the larger part of the third and fourth years is devoted to the study and solution of actual problems in landscape architecture. At the same time, the courses in Elementary Architecturul Design, and in the Technical and Historical Development of the Ancient and Modern Styles are planned to give, in addition to valuable training in appreciation of good design in architecture, some actual knowledge of how to handle the minor problems of an architectural nature rising in connection with most landscape work, especially formal gardens. They also give a sufficient knowledge of architectural methods to prepare for intelligent conference with architects in regard to problems in which the two professions merge.

The examinations for admission to this four years' programme are the same as those required for the other departments of the Lawrence Scientific School. Candidates for admission intending to pursue the landscape course are strongly urged to offer Botany, Freehand Drawing, Projections, Elementary and Advanced Physics, and both French and German. Students who fulfil the requirements of the following programme and present a satisfactory thesis will be admitted to the degree of Bachelor of Science in Landscape Architecture.

First Year

Principles of Delineation (Fine Arts 1).

Mon., Wed., Fri., at 2.30, and additional hours for drawing. (VII)

Technical and Historical Development of the Ancient Styles of Architecture (Architecture 1*a*).

Mon., Wed., Fri., at 12, and additional hours for drawing. (V)

Elementary Architectural and Landscape Drawing (Architecture 2*a*).

Tu., Th., 2.30–4.30, and at least ten other hours. (XV)

Trigonometry (Engineering 1*b*).

I (*first half-year*), *Tu., Th., Sat., at 10;* *or* II (*second half-year*), *Tu., Th., Sat., at 10.* (XI)

Elementary Botany (Botany 1).

Tu., Th., at 10; laboratory work, *four hours a week. Second half-year.* (XI)

Rhetoric and English Composition (English *A*).

I, *Mon., Wed., Fri., at 10;* II, *Mon., Wed., Fri., at 11;* III, *Mon., Wed., Fri., at 12;* IV, *Tu., Th., Sat., at 10;* V, *Tu., Th., Sat., at 11;* VI, *Tu., Th., Sat., at 12.* (XVI)

German *or* French, *one full course in addition to the admission requirements.*

SUMMER.

Surveying (Engineering 4*a* and 4*d*).
Eight weeks at Squam Lake, N. H., beginning as early as possible in June.

SECOND YEAR

Principles of Landscape Architecture (Landscape Architecture 1).
Mon., Wed., Fri., at 9. (II)

Principles of Design in Architecture, Sculpture, and Painting (Fine Arts 2).
Mon., Wed., Fri., at 3.30. (VIII)

Elementary Architectural Design (Architecture 4*a*).
Mon., 2–4.30, and at least twelve other hours a week. (VII)

†Technical and Historical Development of Renaissance and Modern Architecture (Architecture 1*c*). Not given in 1904–05.
Mon., Wed., Fri., at 10. (III)

Or Physiography of the Lands (Geology *A*).
Mon., Wed., Fri., at 11; laboratory work (*two hours a week*) in sections as follows: I, *Mon., 1.30–3.30;* II, *Tu., 9–11;* III, *Tu., 11–1;* IV, *Th., 1.30–3.30.* (IV)

And Forest Botany (Forestry 3).
Mon., Wed., at 9, with additional hours for field work. (II)

Horticulture (Horticulture 1*a*). *At the Bussey Institution.*
Tu., Th., 11.30–2.30; Sat., 10.30–12.30.

*Trees and Shrubs (Horticulture 1*c*). *At the Bussey Institution.*
Sat., 9.30–10.30, and at least two other hours.

Or Hardy Perennials (Horticulture 1*d*). *At the Bussey Institution.*
Sat., 9.30–10.30.

Road Building and Maintenance (Engineering 4*e*).
Mon., Wed., at 11, and during April and May, Th., 1.30–4.30. Second half-year. (IV)

‡English Composition (English *BC*).
Wed., 1.30, and a second hour at the pleasure of the instructor. (VI)

Or ‡English Composition (English 22 or 31, as a half-course).
English 22, *Tu., Th., at 2.30, and conferences at hours to be announced. First half-year.* (XV)

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† Architecture 1c is given in alternate years, and the student is required to alternate this course with Geology *A* and Forestry 3.

* Horticulture 1c is given in alternate years, and the student is required to alternate this course with Horticulture 1*d*.

‡ Prescribed for those students only who have not attained Grade C in English ***A***.

English 31, *Tu., Th., at 2.30, and conferences at hours to be announced. First half-year.* (XV)

THIRD YEAR

Practice in Design, *first course* (Landscape Architecture 2).
Mon., Wed., Fri., 2–5, and additional hours. (VI)

Freehand Drawing (Architecture 3*a*).
Two sections: I, *Mon., Wed., Fri., at 9, and three other hours;* II, *Tu., Th., Sat., at 9, and three other hours.* (II or X)

Physiography of the Lands (Geology *A*).
Mon., Wed., Fri., at 11; laboratory work (*two hours a week*) in sections as follows: I, *Mon,, 1.30–3.30;* II, *Tu., 9–11;* III, *Tu., 11–1;* IV, *Th., 1.30–3.30.* (IV)

And Forest Botany (Forestry 3).
Mon., Wed., at 9, with additional hours for field work. (II)

Or §Technical and Historical Development of Renaissance and Modern Architecture (Architecture 1*c*). Not given in 1904–05.
Mon., Wed., Fri., at 10. (III)

Plants in Relation to Planting Design (Horticulture 2). *At the Bussey Institution.*
Tu., 2.30–4.30, and at least two other hours.

†Hardy Perennials (Horticulture 1*d*). *At the Bussey Institution.*
Sat., 9.30–10.30, and at least two other hours.

Or Trees and Shrubs (Horticulture 1*c*). *At the Bussey Institution.*
Sat., 9.30–10.30, and at least other hours.

Elementary Geology (Geology 4).
Mon., Wed., Fri., at 12. First half-year. (V)

Elementary Field and Laboratory Geology (Geology 5).
Wed., and usually Fri., at 12.
In February and March: laboratory work, *two hours, twice a week,* in sections: Section A, *Tu., Th., 10–12;* or B, *Tu., Th., 1.30–3.30;* or C, *Wed., Fri., 1.30–3.30. In April and May:* field work, *Th.* or *Fri.* (*one half-day a week*), and laboratory or field work, *Tu.* or *Wed. Second half-year.* (V)

Silviculture (Forestry 1).
Tu., Th., at 12, and additional hours for field work. First half-year. (XIII)

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§ See note on page 133.

† Horticulture 1*d* is given in alternate years and the student is required to alternate the course with Horticulture 1*c*.

FOURTH YEAR

Practice in Design, *second course* (Landscape Architecture 3).
Mon., Wed., Fri., 2–5, and additional hours. (VI)

Planting Design (Horticulture 3). *At the Bussey Institution.*
Th., 2.30–4.30.

Freehand Drawing, *second course* (Architecture 3*b*).
Two sections: I, *Mon., Wed., Fri., at 9, and three other hours;* II, *Tu., Th., Sat., at 9, and three other hours.* (II or X)

Water Supply and Sanitary Engineering (Engineering 6*c*).
Mon., Wed., Fri., at 10, and three hours of laboratory work. First half-year. (III)

Building Stones, Masonry, and Foundations (Engineering 8*a*).
Mon., Wed., and Fri., at 11, for one third of the half-year; for the remainder of the half-year, Tu., Th., Sat., at 11. Second half-year. (IV and XII)

Contracts and Specifications (Engineering 22).
Sat., at 12. Second half-year. (XIII)

Thesis.

Reading specifically required in 1903–04: Hamerton, *Landscape*, Chaps. 1, 2, 7, 13, 18, 22, 23, 30, 32, 33, 35, 37; Santayana, *Sense of Beauty*, Pt. III; Homer, *Odyssey*, Bk. VII, account of garden of Alcinoüs; Pliny, the younger, *Letters*, Bk. II, letter 17, and Bk. V, letter 6; Temple, *Gardens of Epicurus;* Hamlin, *Italian Formal Garden* [In European and Japanese Gardens]; Reynolds, *Villas of Rome* [Arch. Record, vol. VI, No. 3, and vol. VII, No. 1]; Bacon, *Of Gardens* [Essay 46]; Howard, *French Gardening and Its Master* [In European and Japanese Gardens]; Sieveking, *Gardens Ancient and Modern*, bot. p. 102–top p. 110; Ernouf et Alkland, *L'Art des Jardins*, pp. 62–94 inclus.; Amherst, *Hist. of Gardening in England*, chap. 6; Blompier and Thomas, *Formal Garden in England*, chaps. 1, 2, 3, 4, 6; Robinson, *Garden Design and Architects' Gardens;* Nichols, *English Pleasure Gardens*, chap. 9; Sturgis, *English Gardens* [In European and Japanese Gardens]; Olmsted and Vaux, *Observations on the Progress of Improvement in Street Plans, with special reference to the Park-Way Proposed to be laid out in Brooklyn, N. Y.* [In 8th. Ann. Report, Brooklyn Park Commissioners, 1868]; Repton, *Sketches and Hints on Landscape Gardening*, chap. 7, with notes and appendix, and *Theory and Practice of Landscape Gardening*, chap. 7; Sieveking, *Gardens Ancient and Modern*, pp. 383–413 inclus.; Whately, *Observations on Modern Gardening*, Sects. I–XXV inclus., XXX, XXXI, and XXXV; Addison, *Spectator*, Nos. 414 and 477; Pope, *Guardian*, No. 173; Eliot, *Vegetation and Scenery in the*

Metropolitan Reservations of Boston; Scott, *Essay on Landscape Gardening* [In Quarterly Review, Mar. 1828, and *Collected Essays*, vol. 3]; Olmsted, *Justifying Value of a Public Park* [In Public Parks]; Olmsted, *Notes on the Plan of Franklin Park;* Eliot, *Prel. Report to Met. Pk. Com. of Boston;* Kemp, *How to Lay Out a Garden*, Pts. 1 and 2; Van Rensselaer, *Art Out of Doors*, and *A Suburban Country Place* [In Cent. Mag., May '97]; Gilpin, any one of following nine volumes, *Forest Scenery*, vols. 1 and 2; *Mountains and Lakes of Cumberland and Westmoreland*, vols. 1 and 2; *Highlands of Scotland*, vols. 1 and 2; *River Wye and So. Wales* together with *Hampshire*, *Sussex*, and *Kent; Cambridge*, *Norfolk*, *Suffolk*, and *Essex; West of England and Isle of Wight.*

FORESTRY.

This programme of study is intended to prepare men for professional work in Forestry, either in the government service or in a private capacity.

A student of Forestry who prefers to take his undergraduate course in Harvard College can take at least half of the courses in Forestry while on his way to the degree of Bachelor of Arts, and can then pursue the advanced courses while registered in either the Scientific School as a candidate for the S.B. degree in Forestry, or in the Graduate School as a candidate for a Master's degree.

The work of the Fourth year will be arranged so that the last three months can be spent in field work which will complete the course in Forest Management and furnish experience in the practical application of Silviculture, Forest Measurements, Forest Protection, and Forest Surveying.

The student who satisfactorily passes the examinations in the courses named below will be entitled to the degree of Bachelor of Science in Forestry.

First Year.

Trigonometry (Engineering 1*b*).

I, *Tu., Th., Sat., at 10, first half-year; or*, II, *Tu., Th., Sat., at 10, second half-year.* (XI)

Surveying (Engineering 4*a*).

Six weeks in the summer.

Elementary Botany (Botany 1).

Tu., Th., at 10; laboratory practice, *four hours a week. Second half-year.* (XI)

Physiography of the Lands (Geology *A*).

Mon., Wed., Fri., at 11; laboratory work, *two hours a week*, in sections as follows: I, *Mon., 1.30–3.30;* II, *Tu., 9–11;* III, *Tu., 11–1;* IV, *Th., 1.30–3.30. First half-year.* (IV)

Meteorology, elementary course (Geology *B*).

Mon., Wed., Fri., at 3.30; laboratory work, *two hours a week*, in sections as follows: I, *Mon., 1.30–3.30;* II, *Tu., 9–11;* III, *Tu., 11–1;* IV, *Th. 1.30–3.30. Second half-year.* (VIII)

Elementary Geology (Geology 4).

Mon., Wed., Fri., at 12. First half-year. (V)

Elementary Field and Laboratory Geology (Geology 5).

Wed., and usually Fri., at 12.

In February and March: laboratory work, *two hours, twice a week*, in sections: Section A, *Tu., Th., 10–12;* or B, *Tu., Th., 1.30–3.30;* or C, *Wed., Fri., 1.30–3.30. In April and May:* field-work, *Th.* or *Fri., one half-day a week*, and laboratory or field-work, *Tu.* or *Wed. Second half-year.* (V)

Experimental Physics (Physics *C*).

Two lectures (one to the class as a whole, *Th., at 12*, and one to the class in five sections, *Mon., Tu., Wed., Th., and Fri., at 2*); three hours of laboratory work (seven sections: *Mon., Tu., Wed., Th., and Fri., 3–6; Mon. and Tu., 10–1*). (XIII)

Or, General Descriptive Physics (Physics 1).

Tu., Sat., at 12; and laboratory work, *one two-hour exercise a week.* (XIII)

Rhetoric and English Composition (English *A*).

Divided into sections. I, *Mon., Wed., Fri., at 10;* II, *Mon., Wed., Fri., at 11;* III, *Mon., Wed., Fri., at 12;* IV, *Tu., Th., Sat., at 10;* V, *Tu., Th., Sat., at 11;* VI, *Tu., Th., Sat. at 12.* (XVI)

One full course in German *or* French in addition to the admission requirements.

SECOND YEAR.

Forest Botany (Forestry 3).

Mon., Wed., at 9, with additional hours for field work. (II)

Analytic Geometry (Engineering 1*d*).

Mon., Wed., Fri., at 10 or 11. Second half-year. (III)

Or, Plane Analytic Geometry (Mathematics *B*).

Mon., Wed., Fri., at 2.30. Second half-year. (VII)

Morphology of Plants (Botany 2).

Mon., Wed., Fri., at 2.30. Laboratory work. *First half-year.* (VII)

Descriptive Inorganic Chemistry (Chemistry 1).

Mon., Fri., at 12; laboratory work, *Tu., Th., 1.30–3.30*, or *Wed., Fri., 2.30–4.30.* (V)

Zoölogy (Zoölogy 1).

Tu., Th., at 10. Lectures and laboratory exercises. *First half-year.*

Every student is required to take three hours of laboratory work per week in one of the following sections: I, *Fri., 1.30–4.30;* II, *Sat., 9–12;* III, *Mon., 9–12;* IV, *Mon., 1.30–4.30;* V, *Tu., 9–10* and *11–1;* VI, *Tu., 1.30–4.30.* (XI)

The Bacteria, Mycetozoa, and Higher Fungi (Botany 6).

Tu., Th., Sat., at 11. Lectures and laboratory work. *Second half-year.* (XII)

One full course in German *or* French.

THIRD YEAR.

Silviculture (Forestry 1).

Tu., Th., at 12, with additional hours for field work. First half-year. (XIII)

Forest Measurements (Forestry 2).

Mon., Wed., at 11, with additional hours for field and laboratory work. First half-year. (IV)

Morphology, Histology, and Cytology of Flowering Plants (Botany 3*a*).

Tu., Th., at 1.30. Laboratory practice, with lectures and demonstrations. *First half-year.* (XIV)

Œcology and Physiology of Flowering Plants (Botany 3*b*).

Tu., Th., at 1.30. Laboratory practice, with lectures and demonstrations. *Second half-year.* (XIV)

Outlines of Economics (Economics 1).

Tu., Th., Sat., at 11. (XII)

General Climatology (Geology 19).

Mon., Wed., Fri., at 10. Lectures, library work, and a thesis. *First half-year.* (III)

Climatology of the United States (Geology 2).

Mon., Wed., Fri., at 2.30. Lectures, library work, and reports. *Second half-year.* (VII)

General Geology (Geology 8).

Wed., Fri., and occasionally Mon., at 9, with additional hours for conference and field-work. Lectures, field work, reports, and reading. (II)

Fourth Year.

Forest Protection (Forestry 4).
Tu., Th., at 10. Second half-year. (XI)

Forest History (Forestry 5).
Tu., Th., at 10. First half-year. (XI)

Lumbering (Forestry 6).
Tu., Th., at 11. (XII)

Forest Management (Forestry 7).
Mon., Wed., at 10, with additional hours for field work. (III)

The Anatomy, Development, and Phylogeny of the Siphonogama (Higher Gymnosperms and the Angiosperms) (Botany 9).
Tu., Th., at 9. Lectures and laboratory work. *First half-year.* (X)

During the second half-year a thesis is required which is to count as half a course.

CHEMISTRY.

This programme of study is intended for students preparing to become practical chemists or teachers of the science.

The degree of Bachelor of Science in Chemistry will be conferred on students who complete this programme, pass the required examinations, and present a satisfactory thesis.

The instruction in Chemistry is given in Boylston Hall.

First Year.

Descriptive Inorganic Chemistry (Chemistry 1).
Mon., Fri., at 12; laboratory work, *Tu., Th., 1.30–3.30, or Wed., Fri., 2.30–4.30.* (V)

Algebra (Engineering 1*a*).
Mon., Wed., Fri., at 10 or 11. First half-year. (III)

Trigonometry (Engineering 1*b*).
I, *Tu., Th., Sat., at 10, first half-year; or* II, *Tu., Th., Sat., at 10, second half-year.* (XI)

Mechanical Drawing (Engineering 3*a*).
Mon., at 1.30; draughting, *six hours a week;* I, *Mon., Fri., 1.30–4.30:* II, *Tu., Th., 1.30–4.30.* (VI)

*Elementary Physics (Physics *B*).
Lectures, *Wed., at 12*; laboratory work, *one two-hour exercise a week*; and recitations or conferences *one hour a week.* (I and V)

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* Required of those who have not passed Elementary Physics for admission.

Rhetoric and English Composition (English *A*).

Divided into sections. I, *Mon., Wed., Fri., at 10;* II, *Mon., Wed., Fri., at 11;* III, *Mon., Wed., Fri., at 12;* IV, *Tu., Th., Sat., at 10;* V, *Tu., Th., Sat., at 11;* VI, *Tu., Th., Sat., at 12.* (XVI)

German *or* French.

One full course in addition to the admission requirements.

SECOND YEAR.

Analytic Geometry (Engineering 1*d*).

Mon., Wed., Fri., at 10 or 11. (III)

Organic Chemistry (Chemistry 2).

Mon., Wed., Fri., at 9. (II)

Qualitative Analysis (Chemistry 3).

Mon., Wed., Fri., at 11. (IV)

Quantitative Analysis, gravimetric and volumetric (Chemistry 4).

Mon., Wed., Fri., at 3.30. (VIII)

Experimental Physics (Physics *C*).

Two lectures (one to the class as a whole, *Th., at 12*, and one to the class in five sections, *Mon., Tu., Wed., Th., and Fri., at 2*); three hours of laboratory work (seven sections: *Mon., Tu., Wed., Th., and Fri., 3–6; Mon. and Tu., 10–1*). (XIII)

Or General Descriptive Physics (Physics 1).

Tu., Sat., at 12; laboratory work, *one two-hour exercise a week.* (XIII)

English Composition (English *BC*).

Wed., at 1.30, and a second hour at the pleasure of the instructor. Half-course. (VI)

German *or* French.

One full course.

THIRD YEAR.

Differential and Integral Calculus (Engineering 1*c*).

Tu., Th., Sat., at 11. (XII)

The Carbon Compounds (Chemistry 5).

Lectures, *Tu., Th., Sat., at 9.* (X)

The Carbon Compounds (Chemistry 5*a*).

Laboratory work, *six hours a week. Half-course.*

Historical Development of Chemical Theory (Chemistry 8).

Mon., Wed., Fri., at 9. Second half-year. (II)

Advanced Quantitative Analysis (Chemistry 9).
Mon., Wed., Fri., at 2.30. First half-year. (VII)

Gas Analysis (Chemistry 10).
Mon., Wed., Fri., at 2.30. Second half-year. (VII)

One elective course chosen under the direction of the Division from the list given under the Fourth Year.

FOURTH YEAR.

Physical Chemistry (Chemistry 6).
Mon., Wed., Fri., at 12. (V)

Industrial Chemistry (Chemistry 11).
Tu., Th., Sat., at 10. (XI)

Three courses of electives chosen under the direction of the Division from the following list: —

Chemistry 7, 12, 13, 14, 20*a*, 20*b*, 20*c*, 20*d*, 20*e*, 20*f*.
Engineering 3*b*, 11*a*, 12*b*, 13*a*, 16*a*.
Physics 3, 6*a*, 6*b*.
Botany 1, 2, 6.
Zoölogy 1, 2.
Geology 4, 5.
Mineralogy 2, 7, 8.
Mining and Metallurgy 2, 3, 7, 9, 10.

GEOLOGY.

The studies in this programme are designed to furnish a special training for those who wish to prepare themselves for duty in Geological Surveys or for teaching. The studies may, on special application to the Administrative Board of the School, be varied to meet the wants of individual students beyond the limits indicated in the programme.

Students who design entering the School in the autumn of any year are advised to take the Summer Course in Elementary Geology, which is regarded as the equivalent of Geology 4 and 5.

Instruction in Geology is given in the museum, laboratories, and lecture rooms of the Department of Geology in the newly erected wing of the University Museum on Oxford Street.

The degree of S.B. in Geology is conferred on students who complete this programme and pass the required examinations satisfactorily.

FIRST YEAR.

Algebra (Engineering 1*a*).
Mon., Wed., Fri., at 10 or 11. First half-year. (III)

Trigonometry (Engineering 1*b*).
I, *Tu., Th., Sat., at 10, first half-year; or* II, *Tu., Th., Sat., at 10, second half-year.* (XI)

Analytic Geometry (Engineering 1*d*).
Mon., Wed., Fri., at 10 or 11. Second half-year. (III)

Mechanical Drawing (Engineering 3*a*).
Mon., at 1.30; draughting, *six hours a week*, I, *Mon., Fri., 1.30–4.30:* II, *Tu., Th., 1.30–4.30.* (VI)

*Elementary Physics (Physics *B*).
Wed., at 12; laboratory work, *one two-hour exercise a week*, and recitations or conferences *one hour a week.* (I and V)

Descriptive Inorganic Chemistry (Chemistry 1).
Mon., Fri., at 12; laboratory work, *Tu., Th., 1.30–3.30*, or *Wed., Fri., 2.30–4.30.* (V)

Rhetoric and English Composition (English *A*).
Divided into sections. I, *Mon., Wed., Fri., at 10;* II, *Mon., Wed., Fri., at 11;* III, *Mon., Wed., Fri., at 12;* IV, *Tu., Th., Sat., at 10;* V, *Tu., Th., Sat., at 11;* VI, *Tu., Th., Sat., at 12.* (XVI)

One full course in German or French in addition to the admission requirements.

Geology S1 recommended in place of Geology 4 and 5 of the Second year.

SECOND YEAR.

Physiography of the Lands (Geology *A*).
Mon., Wed., Fri., at 11, laboratory work (*two hours a week*) in sections as follows: I, *Mon., 1.30–3.30;* II, *Tu., 9–11;* III, *Tu., 11–1;* IV, *Th., 1.30–3.30. First half-year.* (IV)

†Elementary Geology (Geology 4).
Mon., Wed., Fri., at 12. First half-year. (V)

†Elementary Field and Laboratory Geology (Geology 5).
Wed., and usually Fri., at 12.
In February and March: laboratory work, *two hours, twice a week*, in sections: Section A, *Tu., Th., 10–12;* or B, *Tu., Th., 1.30–3.30;* or C, *Wed., Fri., 1.30–3.30. In April and May:* field-work, *Th. or Fri, one half-day a week*, and laboratory or field-work, *Tu. or Wed. Second half-year.* (V)

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* Physics *B* may be omitted by those students who have passed in Experimental Physics for admission.

† If not anticipated by Geology S1.

Mineralogy (Mineralogy 2).
Mon., Wed., Fri., at 10; and five laboratory hours, to be chosen from the following periods: *Tu., 9–12; 1.30–4.30. Wed. and Fri., 11–1; 1.30–4.30.* (III)

Experimental Physics (Physics *C*).
Two lectures (one to the class as a whole, *Th., at 12*, and one to the class in five sections, *Mon., Tu., Wed., Th., and Fri., at 2*); three hours of laboratory work (seven sections: *Mon., Tu., Wed., Th., and Fri., 3–6; Mon. and Tu., 10–1*). (XIII)

Or General Descriptive Physics (Physics 1).
Tu., Sat., at 12; laboratory work, *one two-hour exercise a week.* (XIII)

Elementary Zoölogy (Zoölogy 1).
Tu., Th., at 10; laboratory exercises may be taken in any one of the following sections: I, *Fri., 1.30–4.30;* II, *Sat., 9–12;* III, *Mon., 9–12;* IV, *Mon., 1.30–4.30;* V, *Tu., 9–10 and 11–1;* VI, *Tu., 1.30–4.30. First half-year.* (XI)

Elementary Botany (Botany 1).
Tu., Th., at 10; laboratory practice, *four hours a week. Second half-year.* (XI)

Surveying (Engineering 4*a*). Summer Work at Squam Lake. *Six weeks*, beginning about June 15.

English Composition (English *BC*).
Wed., at 1.30, and a second hour at the pleasure of the instructor. Half-course. (VI)

THIRD YEAR.

Physiography of the United States (Geology 6).
Mon., Wed., Fri., at 2.30. Second half-year. (VII)

Or [Physiography of Europe (Geology 7).
Mon., Wed., Fri., at 12. Second half-year.] (V)
Omitted in 1904–05.

General Geology (Geology 8).
Wed., Fri. (and occasionally Mon.), at 9, with additional hours for conference and field-work. (II)

Palaeontology (Geology 11).
Tu., Th., at 2.30, with additional laboratory hours. (XV)

Elementary Petrography (Mineralogy 4).
Tu., Th., at 11, and an occasional third hour, with additional laboratory hours. First half-year. (XII)

Advanced Petrography (Mineralogy 12).
Tu., Th., at 11, and an occasional third hour, with additional laboratory hours. Second half-year. (XII)

And either German 1*c*, or a course in French more advanced than French *A*, if not taken before.

Fourth Year.

Mining Geology (Geology 10).
Mon., Wed., Fri., at 12. (V)

Historical Geology (Geology 15).
Wed., at 3.30. (VIII)

Advanced Geological field-work (Geology 22).
Th., at 3.30, and a second hour at the pleasure of the instructor. (XVI)

And two additional courses approved by the Department of Geology.

BIOLOGY.

The instruction in this programme will be given in the Museum of Comparative Zoölogy (see pages 252 to 255 and department pamphlets).

The degree of Bachelor of Science in Biology will be conferred on students who complete this programme satisfactorily, pass the required examinations, and present a satisfactory thesis.

First Year.

Elementary Zoölogy (Zoölogy 1).
Tu., Th., at 10; laboratory exercises may be taken in any one of the following sections: I, *Fri., 1.30–4.30;* II, *Sat., 9–12;* III, *Mon., 9–12;* IV, *Mon., 1.30–4.30;* V, *Tu., 9–10 and 11–1;* VI, *Tu., 1.30–4.30. First half-year.* (XI)

Morphology of Animals (Zoölogy 2).
Mon., Wed., Fri., at 2.30. Laboratory work. *Second half-year.* (VII)

Botany (Botany 1).
Tu., Th., at 10; laboratory practice, *four hours a week. Second half-year.* (XI)

Morphology of Plants (Botany 2).
Mon., Wed., Fri., at 2.30. Laboratory work. *First half-year.* (VII)

*Elementary Physics (Physics *B*).
Lectures, *Wed., at 12;* laboratory work, *one two-hour exercise a week,* and recitations or conference *one hour a week.* (I and V)

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* Physics *B* may be omitted by those students who have passed in Experimental Physics for admission.

Physiography of the Lands (Geology *A*).
Mon., Wed., Fri., at 11; laboratory work (*two hours a week*) in sections as follows: I, *Mon., 1.30–3.30;* II, *Tu., 9–11;* III, *Tu., 11–1;* IV, *Th., 1.30–3.30. First half-year.* (IV)

Meteorology, elementary course (Geology *B*).
Mon., Wed., Fri., at 3.30; laboratory work (*two hours a week*) in sections as follows: I, *Mon., 1.30–3.30;* II, *Tu., 9–11;* III, *Tu., 11–1;* IV, *Th., 1.30–3.30. Second half-year.* (VIII)

Rhetoric and English Composition (English *A*).
Divided into sections. I, *Mon., Wed., Fri., at 10;* II, *Mon., Wed., Fri., at 11;* III, *Mon., Wed., Fri., at 12;* IV, *Tu., Th., Sat., at 10;* V, *Tu., Th., Sat., at 11;* VI, *Tu., Th., Sat., at 12.* (XVI)

German *or* French. One full course.

Second Year.

Morphology, Histology, and Cytology of Flowering Plants (Botany 3*a*).
Tu., Th., at 1.30. Laboratory work. *First half-year.* (XIV)

Œcology and Physiology of Flowering Plants (Botany 3*b*).
Tu., Th., at 1.30. Laboratory work. *Second half-year.* (XIV)

Comparative Anatomy of Vertebrates (Zoölogy 3).
Tu., Th., Sat., at 9. Laboratory work. (X)

Descriptive Inorganic Chemistry (Chemistry 1).
Mon., Fri., at 12; laboratory work, *Tu., Th., 1.30–3.30;* or *Wed., Fri., 2.30–4.30.* (V)

Experimental Physics (Physics *C*).
Two lectures (one to the class as a whole, *Th., at 12*, and one to the class in five sections, *Mon., Tu., Wed., Th., and Fri., at 2*); three hours of laboratory work (seven sections: *Mon., Tu., Wed., Th., and Fri., 3–6; Mon. and Tu., 10–1*). (XIII)

Or General Descriptive Physics (Physics 1).
Tu., Sat., at 12; laboratory work, *one two-hour exercise a week.* (XIII)

English Composition (English *BC*).
Wed., at 1.30, and a second hour at the pleasure of the instructor. (VI)

German *or* French. One full course.

THIRD YEAR.

Four courses are required for the third year. Of these the following two and a half courses are prescribed: —

*[The Algae, Liverworts, and Mosses (Botany 4).
Tu., Th., Sat., at 11. Second half-year.] (XII)
Omitted in 1904–05.

Or, The Bacteria, Mycetozoa, and Higher Fungi (Botany 6).
Tu., Th., Sat., at 11. Second half-year. (XII)

Microscopical Anatomy (Zoölogy 4).
Mon., Wed., Fri., at 10. First half-year. (III)

Elementary Geology (Geology 4).
Mon., Wed., Fri., at 12. First half-year. (V)

Qualitative Analysis (Chemistry 3).
Mon., Wed., Fri., at 11. (IV)

The remaining course and a half must be selected from the following list, but students proposing to do their fourth-year thesis work in Zoölogy must include in their election Zoölogy 5.

Embryology of Vertebrates (Zoölogy 5).
Mon., Wed., Fri., at 10. Second half-year. (III)

Fossil Invertebrates (Zoölogy 9).
Tu., Th., and, at the pleasure of the instructor, Sat., at 10. First half-year. (XI)

Fossil Invertebrates (Zoölogy 9*a*).
Tu., Th., at 10. Second half-year. (XI)

†Experimental Morphology. — Ontogenesis (Zoölogy 10).
Tu., Th., at 3.30. (XVI)

Or †[Variation and Heredity (Zoölogy 11).
Tu., Th., at 3.30.] (XVI)
Omitted in 1904–05.

[Comparative Histology (Zoölogy 13).
Mon. Wed., Fri., at 3.30. First half-year.] (VIII)
Omitted in 1904–05.

[The Structure and Functions of the Nervous System and its Relation to Animal Habits. — Sense Organs (Zoölogy 15).
Mon., Wed., Fri., at an hour to be arranged. Second half-year.] (VIII)
Omitted in 1904–05.

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* Given in alternate years. † Given in alternate years.

Or The Structure and Functions of the Nervous System and its Relation to Animal Habits. — Central Nervous Organs and Terminal Organs of Efferent Nerves (Zoölogy 16).
Mon., Wed., Fri., at an hour to be arranged. Second half-year.
Zoölogy 15 and 16 are given in alternate years. (VIII)

Outlines of Economic Botany (Botany 5).
Tu., Th., at 9. (X)

The Theory of Light in its application to familiar optical phenomena and to optical instruments (Physics 2).
Tu., Th., Sat., at 10. First half-year. (XI)

The Carbon Compounds (Chemistry 5).
Tu., Th., Sat., at 9. (X)

The Carbon Compounds (Chemistry 5*a*).
Laboratory work, *six hours a week.*

Elementary Field and Laboratory Geology (Geology 5).
Wed., and usually Fri., at 12.
In February and March: laboratory work, *two hours, twice a week,* in sections: Section A, *Tu., Th., 10–12;* or B, *Tu., Th., 1.30–3.30;* or C, *Wed., Fri., 1.30–3.30. In April and May:* field-work, *Th.* or *Fri., one half-day a week,* and laboratory or field work, *Tu.* or *Wed. Second half-year.* (V)

Advanced French (French 1*c*).
Mon., Wed., Fri., at 9. (II)

General Introduction to Philosophy (Philosophy 1*a*).
Mon., Wed., Fri., at 2.30. (VII)

FOURTH YEAR.

Four full courses are required for the Fourth Year.

In this year the student must pursue some original investigation to the extent of at least two courses under the direction of one of the Instructors in the Department of Botany or of Zoölogy. During the first week of the year he must arrange with his special Instructor the plan of study which he proposes. At the end of the year he must present a thesis, giving the results of his studies.

The courses in which research can be conducted are the following: —

Experimental Vegetable Physiology (Botany 20*a*).

Structure and Development of Cryptogams (Botany 20*b*).

Anatomy and Development of Vertebrates and Invertebrates (Zoölogy 20*a*).

The remainder of the Fourth-Year work must be selected from the following list: Botany 4* *or* 6*, 5; Zoölogy 5, 9, 9*a*, 10, 11, 13, 15*, 16*; Geology 5; French 1*c*; Physics 2; Chemistry 5; Philosophy 1*a*. See the list under Third Year.

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* Given in alternate years.

ANATOMY AND PHYSIOLOGY.

The aim of this programme is to afford a suitable training in science for students who intend to pursue the study of Medicine. Only those branches of science which are recommended by the Medical Faculty of Harvard University are prescribed, together with two years of instruction in Modern Languages. Students who desire some work in Literature, History, Mathematics, or Arts may elect a course each year in any of those subjects. Students who have satisfactorily completed the required work of the first three years of this programme will be admitted to the Harvard Medical School on leave of absence from the Scientific School. The first year in the Medical School will be counted as the fourth year of this programme. The degree of Bachelor of Science in Anatomy and Physiology will be conferred on students who have completed this course of study and who have satisfactorily passed the prescribed examinations.

First Year.

Elementary Zoölogy (Zoölogy 1).

Tu., *Th.*, *at 10;* laboratory exercises may be taken in any one of the following sections: I, *Fri.*, *1.30–4.30;* II, *Sat.*, *9–12;* III, *Mon.*, *9–12;* IV, *Mon.*, *1.30–4.30;* V, *Tu.*, *9–10 and 11–1;* VI, *Tu.*, *1.30–4.30.* *First half-year.* (XI)

Botany (Botany 1).

Tu., *Th.*, *at 10;* laboratory practice, *four hours a week.* *Second half-year.* (XI)

*Elementary Physics (Physics *B*).

Lectures, *Wed.*, *at 12;* laboratory work, *one two-hour exercise a week*, and recitations or conferences, *one hour a week.* (I and V)

Descriptive Inorganic Chemistry (Chemistry 1).

Mon., *Fri.*, *at 12;* laboratory work, *Tu.*, *Th.*, *1.30–3.30*, *or Wed.*, *Fri.*, *2.30–4.30.* (V)

Rhetoric and English Composition (English *A*).

Divided into sections. I, *Mon.*, *Wed.*, *Fri.*, *at 10;* II, *Mon.*, *Wed.*, *Fri.*, *at 11;* III, *Mon.*, *Wed.*, *Fri.*, *at 12;* IV, *Tu.*, *Th.*, *Sat.*, *at 10;* V, *Tu.*, *Th.*, *Sat.*, *at 11;* VI, *Tu.*, *Th.*, *Sat.*, *at 12.* (XVI)

German *or* French.

One full course.

And one full course of elective study.

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* Physics *B* may be omitted by those students who have passed in Experimental Physics for admission.

SECOND YEAR.

Morphology of Plants (Botany 2).
Mon., Wed., Fri., at 2.30. Laboratory work. *First half-year.* (VII)

Morphology of Animals (Zoölogy 2).
Mon., Wed., Fri., at 2.30. Laboratory work. *Second half-year.* (VII)

Experimental Physics (Physics *C*).
Two lectures (one to the class as a whole, *Th., at 12*, and one to the class in five sections, *Mon., Tu., Wed., Th., and Fri., at 2*); three hours of laboratory work (seven sections: *Mon., Tu., Wed., Th., and Fri., 3–6; Mon. and Tu., 10–1*). (XIII)

Or General Descriptive Physics (Physics 1).
Tu., Sat., at 12; laboratory work, *one two-hour exercise a week.* (XIII)

Qualitative Analysis (Chemistry 3).
Mon., Wed., Fri., at 11. (IV)

English Composition (English *BC*).
Wed., at 1.30, and a second hour at the pleasure of the instructor. Half-course. (VI)

German *or* French. *One full course.*

And one full course of elective study.

THIRD YEAR.

Elementary Anatomy and Physiology (Hygiene 1).
Tu., Th., Sat., at 10; laboratory work, *two hours a week*, in sections. (XI)

Comparative Anatomy of Vertebrates (Zoölogy 3).
Tu., Th., Sat., at 9; laboratory work, *six hours a week.* (X)

Meteorology (Geology *B*).
Mon., Wed., Fri., at 3.30; laboratory work (*two hours a week*) in sections as follows: I, *Mon., 1.30–3.30;* II, *Tu., 9–11;* III, *Tu., 11–1;* IV. *Th., 1.30–3.30. Second half-year.* (VIII)

Logic and Psychology (Philosophy 1*a*).
Mon., Wed., Fri., at 2.30. (VII)

And one and one-half courses of elective study.

FOURTH YEAR.

(AT THE MEDICAL SCHOOL.)

Anatomy.
Physiology.
Histology.
Physiological Chemistry.

FOR TEACHERS OF SCIENCE.

This programme is intended for men who wish to qualify themselves to teach science in secondary schools or to become supervisors of science teaching in elementary schools. The work of the first year is prescribed. During each of the remaining three years the student must complete five courses, one of which must be a course in Education; the other four courses the student chooses for himself, but he must obtain his adviser's approval of his choice of studies for each year.

It will be observed that this four years' programme combines professional training for teachers and supervisors of teaching with training in science. The several courses in Education are designed to furnish this professional training.

Through arrangements made with neighboring cities and towns, students have special opportunities to *teach for practice under direction* in these places.

The attention of graduates of normal schools is especially called to this programme.

Graduate Students and other advanced students in the courses in Education annually organize a conference. The meetings are held once a fortnight, and are devoted either to general discussion of some topic of common interest or to an address by some prominent teacher or school officer.

The degree of Bachelor of Science for Teachers of Science will be conferred on all students who complete this programme satisfactorily.

Prescribed Work of the First Year.

Algebra (Engineering 1*a*).
Mon., Wed., Fri., at 10 or 11. First half-year. (III)

Trigonometry (Engineering 1*b*).
I, *Tu., Th., Sat., at 10, first half-year;* or II, *Tu., Th., Sat., at 10, second half-year.* (XI)

Analytic Geometry (Engineering 1*d*).
Mon., Wed., Fri., at 10 or 11. Second half-year. (III)

General Introduction to Philosophy (Philosophy 1*a*).
Mon., Wed., Fri., at 2.30. (VII)

*Elementary Physics (Physics *B*).
Wed., at 12; laboratory work, *one two-hour exercise a week,* and recitations or conferences, *one hour a week.* (I and V)

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* Physics *B* may be omitted by students who passed Elementary Experimental Physics for admission.

And Descriptive Inorganic Chemistry (Chemistry 1).
Mon., Fri., at 12; laboratory work, *Tu., Th., 1.30–3.30, or Wed., Fri., 2.30–4.30.* (V)

Or Experimental Physics (Physics *C*).
Two lectures (one to the class as a whole, *Th., at 12,* and one to the class in five sections, *Mon., Tu., Wed., Th., and Fri., at 2*); three hours of laboratory work (seven sections: *Mon., Tu., Wed., Th., and Fri., 3–6; Mon. and Tu., 10–1*). (XIII)

Or General Descriptive Physics (Physics 1).
Tu., Sat., at 12; laboratory work, *one two-hour exercise a week.* (XIII)

Rhetoric and English Composition (English *A*).
Divided into sections. I, *Mon., Wed., Fri., at 10;* II, *Mon., Wed., Fri., at 11;* III, *Mon., Wed., Fri., at 12;* IV, *Tu., Th., Sat., at 10;* V, *Tu., Th., Sat., at 11;* VI, *Tu., Th., Sat., at 12.* (XVI)

And also one full course in German or French in addition to the admission requirements.

SECOND, THIRD, AND FOURTH YEARS.

During the second, third, and fourth years the student must complete five courses or their equivalent each year, to be chosen with the approval of his adviser, one course each year being selected from the courses in Education.

GENERAL SCIENCE.

This programme of study is intended for those who wish to lay a broad foundation for subsequent special work in Science. The studies in the first-year are prescribed. In the three subsequent years the studies must be chosen under the supervision of a committee of the Faculty. Students must consult the Chairman, Professor Wolff, Room 22, Geological Section, University Museum. For each of these three years five courses are required, and of these fifteen courses at least eight must be scientific, and two of the remaining seven must be in Modern Languages. At least two of the eight scientific courses must be taken each year; four of these must be in one Division of Science, and, of the four, at least one must be taken each year. The respective Divisions will prescribe the specific courses and their sequence for these three years. One full course (or two half-courses) in each of five of the following Departments of Physical or Natural Science must be taken during the four years (but these five courses include the prescribed Physics or Chemistry of the Freshman year): Physics, Chemistry, Zoölogy, Botany, Astronomy, Mineralogy, Geology.

The following courses are prescribed by the respective Divisions: —

PHYSICS.

Physics 3, 4, 5, 6 (or 11[1] and 12[1]).

CHEMISTRY.

Chemistry 1, 2, 3, 4, and 8; if the student has taken Chemistry 1 in the first year, either Chemistry 5 or 6 will be required to complete the prescription of four courses in Chemistry during the last three years.

ENGINEERING.

The four required courses in Engineering must ordinarily include Engineering 5*a* and the courses which lead up to it.

BIOLOGY.

The courses must include Zoölogy 1 and 2, Botany 1 and 2, and two other courses from either Botany or Zoölogy.

GEOLOGY.

The Geology courses must include either Geology 22, or 20, or 11, or 26, or Mineralogy 4[1] and 12[2], or Geology 10, or Mining 1.

The degree of Bachelor of Science in General Science will be conferred on the student who completes this programme satisfactorily.

PRESCRIBED STUDIES FOR THE FIRST YEAR.

Algebra (Engineering 1*a*).
Mon., Wed., Fri., at 10 or 11. First half-year. (III)

Trigonometry (Engineering 1*b*).
I, *Tu., Th., Sat., at 10, first half-year; or* II, *Tu., Th., Sat., at 10, second half-year.* (XI)

Analytic Geometry (Engineering 1*d*).
Mon., Wed., Fri., at 10 or 11. Second half-year. (III)

Mechanical Drawing (Engineering 3*a*).
Lectures, *Mon., at 1.30;* draughting, six hours a week. I, *Mon., Fri., 1.30–4.30;* II, *Tu., Th., 1.30–4.30.* (VI)

*Experimental Physics (Physics *B*).
Wed., at 12; laboratory work, *one two-hour exercise a week,* and recitations or conferences, *one hour a week.* (I and V)

And Descriptive Inorganic Chemistry (Chemistry I).
Mon., Fri., at 12; laboratory work, *Tu., Th., 1.30–3.30, or Wed., Fri., 2.30–4.30.* (V)

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* Physics *B* may be omitted by students who passed Elementary Experimental Physics for admission.

Or Experimental Physics (Physics *C*).

Two lectures (one to the class as a whole, *Th., at 12*, and one to the class in five sections, *Mon., Tu., Wed., Th., and Fri., at 2*); three hours of laboratory work (seven sections: *Mon., Tu., Wed., Th., and Fri., 3–6; Mon. and Tu., 10–1*). (XIII)

Or General Descriptive Physics (Physics I).

Tu., Sat., at 12; laboratory work, *one two-hour exercise a week.* (XIII)

Rhetoric and English Composition (English *A*).

Divided into sections. I, *Mon., Wed., Fri., at 10;* II, *Mon., Wed., Fri., at 11;* III, *Mon., Wed., Fri., at 12;* IV, *Tu., Th., Sat., at 10;* V, *Tu., Th., Sat., at 11;* VI, *Tu., Th., Sat., at 12.* (XVI)

One full course in German or French in addition to the admission requirements.

SECOND,† THIRD, AND FOURTH YEARS.

During the second, third, and fourth years the student must take five courses or their equivalent each year, to be chosen with the approval of the supervising Committee (see above).

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† Students who pass English *A* of the first year with a grade of *C*, or lower, are required to take English *BC* in their second year in addition to the five elective coursse.

DESCRIPTIONS OF COURSES.*

The following brief descriptions of the courses required in the various programmes are added for the information of those who contemplate entering the School.

GREEK AND ROMAN ARCHAEOLOGY.

GREEK 10. — The Life of the Ancient Athenians, described and illustrated by the aid of the Literature and of the Monuments. Lectures; required reading; two reports. Asst. Professor GULICK.

Greek 10 is given alternately with Latin 10, and is open to Juniors, Seniors, and Graduates.

The course is intended both for classical students and for others who have not devoted special attention in college to the classics, but who may nevertheless wish to make a systematic study of old Greek life. The instructor will explain in an elementary way, but systematically, how the ancient Athenians lived. He will describe, for example, their houses and how they were furnished; their dress, coverings for the head and feet, and personal ornaments; their system of education; their marriage and funeral rites; entertainments, in-door and outdoor sports, markets, shops, exports, and imports; the trades and professions among them; their country life; their means of conveyance; how the ship was constructed, manned, and rigged; how the horse was bridled and harnessed, etc. The lectures will be illustrated as fully as possible by means of diagrams, casts of works of ancient art, books on art, and the stereopticon, which is provided with over two thousand slides.

The course is given by lectures, but members of the class will be required to prepare for examination, parts of the books named below, and occasionally also parts of other English books of reference. Of these the instructor will give some explanation and description at the first lecture.

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* The courses described herein are those named in one or more of the twelve programmes of study in the Lawrence Scientific School. The student is referred to the Announcement of Courses of Instruction provided by the Faculty of Arts and Sciences, and to the special announcements of the several departments, for complete lists of courses offered by the Faculty of Arts and Sciences.

No collateral reading will be required in any other language than English; but the instructor will give references also to valuable works written in German and French for the benefit of those who can use these languages. All the books to which reference is made will be reserved for the use of the class in the College Library or in the Library of the Classical Department. Each member of the course will be required to write two short theses involving elementary investigation. This course is introductory to Classical Philology 37.

Smith's *Dictionary of Antiquities* (third edition in two vols., 1890, Little, Brown, and Co., Boston, $7.00 each vol.). Guhl and Koner's *Life of the Greeks and Romans* (Appleton & Co., New York, $2.50), or preferably the sixth German edition under the title, *Das Leben der Griechen und Römer* (Weidmann, Berlin, *M.* 20). Blümner's *Home Life of the Ancient Greeks*, translated by Alice Zimmern (Cassell & Co., London, $2.00), or preferably the sixth German edition under the title, *Leben und Sitten der Griechen* (Freytag, Leipzig, *M.* 4.80). Gardner and Jevons' *Manual of Greek Antiquities* (Charles Scribner's Sons, New York, $4.00). Schreiber's *Atlas of Classical Antiquities* (The Macmillan Co., New York, $6.50). Gulick, *The Life of the Ancient Greeks* (D. Appleton & Co., $1.40).

[LATIN 10. — The Private Life of the Romans. — Lectures; study of ancient representations; required reading and two short theses on special topics. Professor MORGAN.]

Omitted in 1904–05.

Latin 10 is given alternately with Greek 10, and is open to Juniors, Seniors, and Graduates.

This course is conducted in the same general way as Greek 10, and is intended to give, by lectures and the use of the stereopticon, as complete a representation as possible of Roman private life. The equipment for this purpose includes the best illustrated works on classical antiquities, which are accessible to the student in the Library of the Department or in the College Library, and fourteen hundred stereopticon slides. In addition to the examinations each student will be required to make two reports on special topics in a much more minute way than the same topics can be treated in the lectures.

ENGLISH.

English *A*. — Rhetoric and English Composition. — A. S. Hill's *Principles of Rhetoric* (revised and enlarged edition). — Lectures, recitations, written exercises, and conferences. Asst. Professor Hurlbut, Mr. Copeland, Dr. Maynadier, and others.

Asst. Professor Hurlbut will have the general direction of Course *A*.

Course *A* is prescribed for Freshmen and for first-year students in the Scientific School unless anticipated by examinations. For examinations it is placed in Group XVI.

In the daily exercises the class will be divided into six sections; but at the Mid-Year and Final Examinations the whole class will be examined together.

Course *A* gives instruction in the theory and the practice of English Composition. The theory of composition is taught throughout the year by lectures based on A. S. Hill's *Principles of Rhetoric* (revised and enlarged edition), and by oral and written exercises. The practice is obtained in daily themes, some of which are written in the class-room on topics announced after the class has assembled; and in longer themes, prepared at intervals of about a fortnight. The long themes and a considerable number of the daily themes are criticised in detail by the instructors and returned to the writers to be rewritten, some in the class-room under the immediate supervision of an instructor.

For the writing of class-room themes the class is divided into six sections, which meet the instructors on Wednesdays or Thursdays; for the study of Rhetoric and the rewriting of themes in the class-room each section is subdivided into three or more parts. Furthermore, regular consultation hours are appointed; and each student is required, at frequent intervals, to discuss his work with his instructor.

In addition to the study of Rhetoric and the writing and rewriting of themes, certain reading is required, usually not more than one book a month. Among the books which have been prescribed are *Henry V*, *Macbeth*, *The Revolt of a Tartar Tribe*, *The Essays of Elia*, *The Scarlet Letter*, *The Golden Treasury*, *Treasure Island*, *The Jungle Book*, *Henry Esmond*, *David Copperfield*, and in general such books as the students in the course might read for their own pleasure.

Undergraduates in Harvard College who pass in Course *A* with Grade *D* are required to take in the ensuing year a half-course in English Composition in addition to their regular elective work.

Students in the Scientific School (except those in the course in General Science) who attain Grade *C*, or a higher grade in Course *A* are exempted from the prescription of Course *BC*. For students in the course in General Science who pass in Course *A* with a grade lower than *B* Course *BC* is prescribed.

ENGLISH *BC*. — English Composition. — Written exercises and conferences. Mr. T. HALL and an assistant.

Course *BC* is open to students of the Scientific School who have passed in Course *A*. It is prescribed for students in the course in General Science who have passed in Course *A* with a grade lower than *B*, and for students in the other courses of the School who have passed in Course *A* with a grade lower than *C*. It is open to no other students, and cannot be counted towards the degree of A.B., except with the permission of the Deans of the College and the Scientific School.

Course *BC* gives instruction in the elements and the qualities of style, and practice in Narration and Description, but mainly in Exposition. It is specially adapted to the needs of students in the Scientific School, and to this end it is closely connected with their other courses.

The class meets at lectures once each week, and each student meets the instructor for personal consultation at least once in two weeks.

The written work consists of daily themes, fortnightly themes, and a thesis of not less than 1500 words. The thesis and some of the fortnightly themes are preceded by plans.

GERMAN.

GERMAN *D*. — Elementary Course. — Grammar; German prose; practice in writing German. Dr. BIERWIRTH, and Messrs. COLWELL and HAGENS.

Course *D* is intended for students of the Scientific School who have not presented German at the examination for admission. The work of the course is conducted in several sections.

The principal aim of Course *D* is to give the student a knowledge of German sufficient to enable him to read easy German at sight.

GERMAN 1*c*. — German Prose, narrative and descriptive. — Reading at sight. Dr. SKINNER and Mr. STURTEVANT.

Course 1*c* is especially intended for students who have taken Course *D*. It is also open to students who have passed in Elementary German for admission or have taken Course *A*. It will not remove a condition in Advanced German.

This course is designed for students who wish to prepare themselves to read scientific or technical German. Besides a considerable amount of narrative and descriptive prose, there will be read selections from Walther's *Meereskunde*, Lassar-Cohn's *Chemie im täglichen Leben*, or other popular scientific books.

FRENCH.

FRENCH *A*. — Elementary Course. — French Prose and Composition.
Dr. MORLEY, with assistants.

There will be at least five sections in this course, but all sections will be examined in Group VIII. The choice of sections, by students who have no conflict with an elective course, is subject to the approval of the instructor. Students in the Lawrence Scientific School are required to enter Section I.

This course is equivalent to the Elementary French of the admission requirements, and is prescribed for Freshmen who did not present French for admission.

The object of the course is to prepare students to follow the more advanced courses, but it may be taken by those desiring simply to acquire a fair reading knowledge of French. The work consists largely of translation from French into English, of sight-reading of simple French, and of translation from English into French, the exercises illustrating the elementary rules of grammar and the simpler rules of syntax, which are required to facilitate sight-reading of simple French prose. During the second half-year connected passages of translation from English into French, and easy dictations in French, form an important part of the work.

The following books will be used: Grandgent, *Essentials of French Grammar* (Heath & Co.); Laboulaye, *Contes bleus* (Heath & Co.); Lesage, *Gil Blas* (Heath & Co.); George Sand, *la Mare au Diable* (Heath & Co.); Bonnechose, *Bertrand du Guesclin* (Macmillan); Labiche, *la Poudre aux yeux* (Holt & Co.); Lamartine, *la Révolution française* (Heath & Co.). At the final examination the student will be expected to have a knowledge of Elementary French grammar, to be able to translate at sight a passage of ordinary French prose, and to write an easy French composition.

FRENCH 1*c*. — Reading, translation, grammar, and composition.
Dr. MORLEY, with an assistant.

Open to students in the Lawrence Scientific School who have passed in Course *A*, or have passed the admission examination in Elementary French.

This course is conducted mainly in English.

The object of this course is to lead the student to understand both the spoken and the written language; to enable him to read easily at sight, and to write with a fair degree of accuracy. The work consists of exercises in composition illustrating the principles of the grammar and the more frequent rules of syntax, of dictations in French, of short summaries of the books read, of much translation of French into English, and of a large amount of sight-reading of French.

The following works will be used: Grandgent, *Essentials of French Grammar* (Heath & Co.); Dumas père, *les Trois Mousquetaires* (Macmillan & Co.); Sarcey, *le Siège de Paris* (Heath & Co.); Bowen, *First Scientific French Reader* (Heath & Co.); Legouvé and Labiche, *La Cigale chez les fourmis* (Ginn & Co.); Mérimée, *Quatre contes* (Holt & Co.); Michelet, *Extraits de l' histoire de France* (Heath & Co.).

Students who desire more instruction in grammar and composition, as well as practice in conversation, are advised to take a course in conversation and composition in addition to this course.

FRENCH 1*b*. — French Prose, historical and general. Translation from French into English. Asst. Professor BABBITT, Dr. M. A. POTTER, and Mr. F. W. SNOW.

This course is conducted in English.

It is open to students who have passed in Course *A*, or have passed the admission examination in Elementary French.

Course 1*b*, in addition to preparing for the more advanced electives, is also intended for those who wish to acquire merely a reading knowledge of French sufficient to enable them to use it as an instrument in connection with other studies. Besides the books read in class, several volumes will be assigned during the year for outside reading. There will be an oral drill on the irregular verbs at the beginning of the year, and the main points of grammar will be reviewed by means of dictations, etc. One exercise a week will be prepared throughout the year in Cameron's *Elements of French Composition* (Holt & Co.).

The following books will be partly read, partly translated: Dumas père, *les Trois Mousquetaires* (Ginn & Co.); Thiers, *Expédition de Bonaparte en Égypte* (Holt & Co.); George Sand, *la Famille de Germandre* (Ginn & Co.); Thierry, *Récits des temps mérovingiens* (Hachette); Alfred de Vigny, *la Canne de jonc* (Heath & Co.); Balzac, *le Curé de Tours* (Heath & Co.); Taine, *les Origines de la France contemporaine* (Holt & Co.).

The books to be used for outside reading will be announced later.

SPANISH.

SPANISH 1. — Grammar, reading, and composition. — Modern Spanish novels and plays. Dr. M. A. POTTER, Dr. MORLEY, and three assistants.

Students are not permitted to elect Italian 1 and Spanish 1 in the same year.

Seniors taking this course cannot, save in exceptional cases, count it towards a degree.

This course is elementary, and its object is to give the essentials of Spanish grammar (both forms and syntax), as a preparation for reading and writing the language. The translation of modern Spanish prose will be begun early in the year; and there will be much practice in rendering easy English into Spanish. Garner's *Spanish Grammar* will be used for the grammatical instruction. Stories and plays by modern authors (Alarcón, Pérez Galdós, Taboada, and others) will be read. It is expected that the student will find himself able at the end of the year to read ordinary modern prose with only occasional difficulties of vocabulary and idiom.

This course or its equivalent is a necessary preparation for Courses 4 and 5.

HISTORY.

HISTORY 1*a*. — Mediaeval History. (Introductory course). Professor HASKINS, assisted by Messrs. BINGHAM, FRYER, OGG, and ——.

For students who have passed in the third course of the Advanced History (European History) in satisfaction of the requirements for admission, Course 1*a* cannot be counted towards the degree of A.B. For Juniors and Seniors it is counted as a half-course only. It is not open to students who have taken Course 1 before 1903, or Course 1*b* in 1903–04.

Course 1*a* may be counted as a half-course for Final Honors and Honorable Mention.

This course offers a general survey of the development of western Europe in the Middle Ages, beginning with the Germanic invasions and extending to the Renaissance. The main emphasis is placed upon the history of the Continent, events in England being considered only in connection with the general history of the period. The course is designed as an introduction to the college study of history, and aims to give some idea of the nature and methods of historical study, as well as to prepare the student to take up intelligently the history of modern times or to study more specially the history and institutions of the Middle Ages. The lectures will not attempt to furnish a continuous narrative, but will dwell upon the more significant aspects of the period. Definite reading will be prescribed from week to week, and the student will also be expected to read more widely in recommended books and to get into the habit of independent reading beyond any expressly required amount. His work will be tested by weekly papers and discussions and by individual conferences with assistants. Attention will also be given to historical geography, and the preparation of outline maps will be required.

GOVERNMENT.

GOVERNMENT 1. Constitutional Government (elementary course). Professor LOWELL, assisted by Dr. PHILBRICK, Messrs. GEORGE, CLARK, and BARR.

Course 1 is recommended for students who expect to take History 12, 13, or 16; and it is not open to students who have taken any one of those courses. It may be taken as a half-course for the first half-year.

For Juniors and Seniors, Course 1 will be counted as a half-course only.

The governments of England and the United States will occupy the first half-year. The second half-year will be devoted to the French, German, Swiss, and other important governments, and to the government of dependencies.

Attention will be given to constitutional law, the composition and powers of representative bodies, relations between the executive and legislative departments, parliamentary procedure, organization and influence of political parties, composition and powers of the courts, etc.

There will be, ordinarily, two lectures each week to the whole class, supplemented by required reading. For the third hour the class will be divided into sections, under the charge of the assistants, for purposes of discussion and examination upon the lectures and the required reading.

ECONOMICS.

ECONOMICS 1. — Outlines of Economics. — Lectures on Social Questions and Monetary Legislation. Professor TAUSSIG, Asst. Professor ANDREW, Messrs. CUSTIS, FIELD, WRIGHT, and ——, and ——.

Course 1 gives a general introduction to economic study, and a general view of Economics for those who have not further time to give to the subject. It undertakes a consideration of the principles of production, distribution, exchange, money, banking, and international trade. The relations of labor and capital, the present organization of industry, and the recent currency legislation of the United States, will be treated in outline.

Course 1 will be conducted partly by lectures, partly by oral discussion in sections. A course of reading will be laid down, and weekly written exercises will test the work of students in following systematically and continuously the lectures and the prescribed reading. Large parts of Mill's *Principles of Political Economy*, of Hadley's *Economics* and of Dunbar's *Theory and History of Banking* will be read; and these books must be procured by all members of the course.

PHILOSOPHY.

PHILOSOPHY 1*a*. — General Introduction to Philosophy. — *First half-year:* Logic, Professor ROYCE. *Second half-year:* Psychology, Professor MÜNSTERBERG. — Jevons's Lessons in Logic; James's Psychology (briefer course); Professors ROYCE and MÜNSTERBERG.

PHILOSOPHY 1*b*. — Outlines of the History of Philosophy. — *First half-year:* Ancient Philosophy, Professor PALMER. *Second half-year:* Modern Philosophy, Dr. PERRY. — Weber's History of Philosophy. Professor PALMER and Dr. PERRY.

Before pursuing higher courses in Philosophy, students must have passed satisfactorily in one of these elementary courses, or must otherwise satisfy the instructor of their fitness to proceed. Both courses are alike intended to cover preparatory ground. They are, however, independent of each other and may be taken together in the same year or in either order in different years. They are counted as full courses; but a Senior can count either of them as a half-course only. No portion of either can be counted independently as a half-course.

The instruction in both courses will be by lectures, by text-books, and by assigned private reading. Each student will meet an assistant in conference at frequent intervals.

EDUCATION.

Education 1. — The History of Educational Theories and Practices. — Lectures, required reading, and reports. Mr. A. O. Norton.

This course deals with the history of experience in education as well as with the more important educational ideals and theories since the fifth century, B.C. About two months are given to Greek and Roman schools; the period from the sixth to the twelfth century is sketched rapidly; the greater part of the year is devoted to education in Italy, France, Germany, and England, since the rise of mediaeval universities. Education in America since 1635 may be considered briefly.

The purpose of the course is to trace the historical development of modern schools and universities, with especial reference to their ideals, studies, modes of teaching, and organization. The varying relations of church and state to Education are considered throughout. Attention is given to the effect of political, social, and religious ideals on the spirit and direction of Education, and to the influence upon school methods and curricula of the general progress of the arts and sciences. The student therefore gains a view of the subject in its relation to general history, as well as a historical basis for sound criticism of the more important elements of modern school systems. A course of reading is prescribed and frequent reports are required.

Education *2a*. — Introduction to the Study of Education. — Discussion of Educational Principles. Lectures, required reading, and reports. Mr. A. O. Norton.

The aim of this course is to enable the student to attain a just conception of the meaning of Education and to make a critical examination of such generally accepted educational principles as may serve to guide him in his further study of educational questions. The meaning and scope of Education are defined, and its aims, means, and methods are examined. The special aims and general method of elementary and of secondary education are treated separately and also in relation to each other. The following topics indicate the general character of the work: The Scope and Meaning of Education; the Fortuitous Education of Experience and Environment; the School as the Chief Means of Specific Education; the Development of the Individual and his Adaptation to the Civilization of his Time; the Special Aims of Elementary and of Secondary Education; Educational Values and Courses of Study; the Relation of Psychology and Ethics to Educational Theory and Practice; the Correlation of

Studies; General Principles of Method; the Bearing of Instruction on Character; Discipline and Moral Training; the Study of Children; School Hygiene; Education as a Function of Society. A course of reading is prescribed, and essays are required.

[*EDUCATION 2*b*.—The Development of Schools and School Systems in America, more particularly in Massachusetts. — Contemporary Tendencies and Problems. Lectures, prescribed reading, and theses. Professor HANUS.]

Omitted in 1904–05.

This course is not intended primarily for students who intend to be teachers, but for those who are interested in the study of Education as a function of society, *i.e.*, for those who wish to study the organization and administration of educational activity as a branch of state and municipal affairs.

The plan of the course comprises (1) a sketch of the development of public and private schools in America, more particularly in Massachusetts, in relation to social and political conditions since 1630, and especially since the Revolution; and (2) a more detailed discussion of contemporary tendencies and problems in the organization and administration of the school systems of four or five important cities of the United States.

The following topics constitute an outline of the course: Educational traditions of the colonists; Important school legislation in Massachusetts; The town "grammar school"; The "common school"; The academy; The public high school; The school committee; Private and endowed schools; The development of town and city school systems; Evolution of supervision; Attempted reforms in the organization and administration of contemporary school systems. A course of reading will be prescribed and theses will be required.

EDUCATION 3. — Organization and Management of Public Schools and Academies. — Supervision, Courses of Study, and Teaching. — Lectures, discussions, and reports. I (advanced section), II (inexperienced graduates and seniors). Mr. A. O. NORTON.

The general aim of this course is to enable all students to become familiar with and to understand the organization and administration of schools and school systems through direct observation and comparative study; to provide for young graduates and other students of suitable age and attainments an opportunity to acquire the art of teaching through study and practice; and to provide, through the opportunity for specialization which the course affords, special preparation for the work of principals and superintendents of schools.

The course will be carried on in two sections, in accordance with the attainments, previous experience, and aims of the students. While much of the work is the same for both sections, the treatment of the same topics will differ somewhat in the two sections; and in Section II special attention will be given to the work of the class-room teacher, while in Section I special attention will be given to the duties of principals and superintendents of schools.

During the year, a limited number of the students of Section II will have an opportunity to teach, under direction, in schools in the vicinity of the University. It is expected that all graduate students who have had no experience as teachers will be able to avail themselves of this privilege to the extent of at least two periods a week during half a year; but this privilege is offered only to students who have a high record in scholarship; and any student who shows persistent unfitness to teach will not be permitted to continue his practice teaching.

In studying the school systems of American cities, a detailed examination of their courses of study will be undertaken, and the principles on which any course of study should be based will be discussed. Attention will be given to details of the organization and administration of schools and school systems. The duties of teachers, principals, and superintendents will be considered separately, and in relation to each other. Students will study, under direction, the work of public schools and academies in the vicinity of the University. Reports of this work, written when required, will be submitted weekly. A course of reading is prescribed.

At the end of the year each student will submit a thesis, in which special attention must be given either to the course of study or to a detailed discussion of organization and management. In the first case, the student will be expected to treat particularly his own specialty, for which all the details of the course of study, the teaching resources, and the methods of teaching, must be fully considered. In the second case, the student must develop his own plan for the organization and administration of a school system in detail.

[EDUCATION 4.—Foreign School Systems.—The school systems of England, France and Germany.—Lectures, required reading and reports. Professor HANUS.]

Omitted in 1904–05.

The aim of this course is to acquaint the student with the chief characteristics of the school systems of England, France, and Germany, and to compare those school systems with each other and with the school systems of the United States. A brief account of the recent history of the school systems of each country will lead to the study of each system as at present organized and administered. The following topics will be treated in some detail: State Control and Local Control of Schools; Financial Support of Schools; Supervision; Elementary Schools, — Courses of Study, Methods, and Discipline; Continuation Schools; Secondary Schools, — Courses of Study, Methods, and Discipline; Rights and Privileges of Secondary School Graduates; the Training of Teachers for Elementary and for Secondary Schools. If time permits, foreign universities will be briefly considered. A course of reading is prescribed and essays are required.

[EDUCATION 10*a*. — The Methods and Equipment of a Teacher of Classics in secondary schools. — Lectures, discussions, required reading, and illustrations of class works. Associate Professor C. P. PARKER.]

Omitted in 1904–05.

The lectures and discussions will deal with the methods of teaching vocabulary, exercises, parsing, reading, etc., to beginners in Latin and Greek. The conversational method and the inductive method will also be considered. The time and manner of using readers, of teaching the various authors used in schools, of giving systematic drill in grammar, of brightening up the daily lesson, of teaching to read at sight, and to write in Latin and Greek — all these will be discussed. The most important text-books will be used and compared. The arrangement of courses in Latin and Greek for high schools and other secondary schools will be examined; the fitting out of the school library and class room with books, maps, etc., will be suggested. Every member of the course is expected to read about a hundred new pages of Latin and as many of Greek. The Friday meetings will be devoted to the discussion of some of these passages from the secondary teacher's point of view. Conflicts on Friday can be avoided by taking the work in sections at other times. The work will be tested at the final examination. Written answers to questions based on the lectures will be expected every week. The final examination will test all the different kinds of work that have been done. No one will be admitted to the course unless he can show that he has made considerable progress in the study of Latin and Greek.

[EDUCATION 10*b*. — The Methods and Equipment of a Teacher of German in Secondary Schools. — Lectures, discussions, required reading, and illustrations of class work. Dr. BIERWIRTH.]

Omitted in 1904–05.

Among the subjects treated in the lectures and discussions are the following: the adaptation of methods to the age and previous training of students; the arrangement of courses in different schools; the choice of text-books; the annotation of texts; the teachers' sources of information; the disciplinary and practical value of the study of German and its relation to the study of English. — Students taking the course are required to prepare reports on grammars, readers, or editions of texts, interpret or annotate new texts, and present to the class some of the more difficult topics in grammar, syntax, and composition.

[EDUCATION 10*c*. The Methods and Equipment of a Teacher of French in secondary schools. Lectures, discussions, required reading, and illustrations of class work.]

Omitted in 1904–05.

The course will include (*a*) the general theory of the teaching of modern languages with the distinctive features of typical methods; (*b*) the applicability of various methods to the conditions of American secondary schools; (*c*) the presentation of special topics in the teaching of French.

The arrangement of courses and the choice of text-books will be considered, and the leading features of French grammar will be concisely treated. Students will be referred to helpful books and periodicals in English, French, and German, and will be required to present reports and abstracts at stated intervals.

[EDUCATION 20*a*. — Seminary. — *Subject for the year:* Contemporary Problems in Education. — Lectures, essays, reports, and discussions. Professor HANUS.]

Omitted in 1904–05.

This course is intended for the most advanced students only. At the outset, a general survey of present problems and contemporary tendencies in educational theory and practice will be undertaken. Soon after the Seminary is organized each student is expected to choose some topic or topics for special study, and later to present the results of this study to the Seminary in the form of at least one extended essay during each half-year. Much stress is laid on the essays and the discussions based on them. Students may work on chosen topics either singly or in groups; and, in general, each member of the Seminary may be called upon by the instructor to coöperate with others for the study of different phases of a single topic, or for the study of related topics. Each student will also be required to present summaries and occasional critical reviews of selected books or monographs.

FINE ARTS.

Fine Arts 1. — Principles of Delineation, Color and Chiaroscuro with some consideration of historic forms of Art and the conditions which have influenced them. — Lectures (once a week) with collateral reading. — Practice in drawing and in the use of water-colors. — Perspective. Professor Charles H. Moore, assisted by Mr. Mower.

This is a course on the theory of the graphic arts as modes of expression. It at the same time includes the study of nature from an artistic point of view, and aims to cultivate the eye, and in some measure to train the hand. The instruction is given by lectures and collateral reading and by practice in drawing with the point and in water-colors. In the drawing and coloring exercises the theoretic aim of this course is kept steadily in view. These exercises serve to fix in the mind of the student the fundamental principles of graphic art, and for the student of architecture a solid foundation is laid for the continued practice in freehand drawing which is to follow.

The books chiefly referred to will be the following: Ruskin's *Modern Painters* and *Elements of Drawing;* Longfellow's *Abstract of Lectures in Perspective;* Sir Joshua Reynold's *Discourses;* Hammerton's *Thoughts about Art.*

Fine Arts 2. — Principles of Design in Architecture, Sculpture and Painting as exemplified in the Arts of past ages. — Lectures (*twice a week*), with collateral reading.— Practice in drawing. Professor Charles H. Moore.

As a preparation for Course 2 it is desirable to have passed satisfactoril in Course 1. See, further, note under Course 4.

Fine Arts 4. — The Fine Arts of the Middle Ages and the Renaissance. Professor Charles H. Moore and an assistant.

Courses 2 and 4 cannot both be counted towards a degree by the same student.

ARCHITECTURE.

ARCHITECTURE 1*a*. — Technical and Historical Development of the Ancient Styles, with special reference to Classic Architecture. — Lectures and practice in drawing. Professor H. L. WARREN, assisted by Mr. SWAN.

This course is intended especially for students in the Lawrence Scientific School who are studying Architecture or Landscape Architecture; but it is open also to students in the College who satisfy the instructor of their fitness to pursue it, and may be counted for the degree of A.B.

The first few weeks of the course are devoted to gaining facility in the simple representation of architectural form, with some study of the elementary principles of projection and perspective drawing and shades and shadows. The history of ancient architecture is then taken up. The gradual development of architectural forms and the technical processes of building are traced, beginning with a summary study of the buildings of Egypt, Assyria, and Persia, and passing on to the more thorough and detailed consideration of the architecture of Greece and Rome. Students are required from time to time to make drawings and written reports in illustration of the lectures. During the course the elements of Classical architectural form, especially the Greek and Roman orders and their uses, are considered. The more important buildings are examined in detail, and the structural and aesthetic principles on which their design depends are studied critically. The course is so conducted as to make the greatest possible use of the library and to familiarize the student with books and their use. The course is not merely historical, but aims to lay the foundation of a working knowledge of architectural form, and thus serves as an introduction both to Courses 1*b* and 1*c*, which continue the history of architecture, and to Course 4*a*, which begins the study of architectural design. The courses in history include a study of ornament and of the principles of ornamental design. The course is illustrated by the use of the stereopticon.

N. B. — The ability to use French and German reference-books with ease will be found valuable, though not essential.

Reference-books: Perrot and Chipiez, *History of Art in Ancient Egypt; — in Chaldaea and Assyria; — in Persia;* Maspero, *Egyptian Archaeology;* Babelon, *Manual of Oriental Antiquities;* Laloux, *l'Architecture grecque;* Durm, *Die Baukunst der Griechen;* Durm, *Die Baukunst der Etruskerund Römer;* Choisy, *l'Art de bâtir chez les Romains;* Bühlmann, *Die Architektur des classischen Alterthums und der Renaissance;* Anderson and Spiers, *The Architecture of Greece and Rome.*

Architecture 1*b*. — Technical and Historical Development of the Mediaeval Styles of Architecture. — Lectures and practice in the drawing-room. Professor H. L. Warren, assisted by Mr. Mowll.

[Architecture 1*c*. — Technical and Historical Development of Renaissance and Modern Architecture. — Lectures and practice in drawing. Professor H. L. Warren, assisted by Mr. Mowll.]

Omitted in 1904–05.

Courses 1*b* and 1*c* may be counted for the degree of A.B. Except by special permission they are open to those students only who have passed in Architecture 1*a*. They are given in alternate years, and are taken by the second- and third-year students registered in the Programme in Architecture of the Scientific School together, so that one set of students, following the chronological order, continues the studies of the first year, which close with the decline of Roman art, by taking up in the second year the study of the Mediaeval art which grew out of that decline, and completes the history of architecture in the Renaissance and Modern styles; while another set of students passes from Roman architecture to its revival in the fifteenth century, and goes back to study the Mediaeval styles.

In these courses the study of the history of architecture is continued by means of lectures illustrated by the stereopticon and the making of written reports and theses, with illustrative drawings by the students. There is the same insistence on the requirement of familiarity with the forms that are met with, and their proper use. From time to time special subjects of research are given out which the students are expected to investigate for themselves, under guidance, by means of engravings and photographs, and upon which written reports will be required. The courses include a careful consideration of structural development. Methods of vaulting in different periods are made familiar to the students by the actual construction by them of large models of vaulting, using precisely the methods that would be employed in the construction of actual vaults.

The endeavor is to study the history of architecture not so much archaeologically as in a more vital way with reference to actual practice; to obtain a knowledge of principles of design by an analysis of the growth of architectural form and its use. The buildings that are studied are regarded not as objects of contemplation or as historical documents, but as examples of various methods of work carried out under certain conditions. Architectural form and composition are thus studied by means of the history of architecture.

Reference-books: In Course 1*b* — Essenwein, *Die Ausgänge der classischen Baukunst;* Essenwein, *Die Fortsetzung der classischen Baukunst im oströmischen Reiche;* Choisy, *l'Art de bâtir chez les Byzantins;* Dehio und v. Bezold, *Kirchliche Baukunst des Abendlandes;* Cummings, *History of Architecture in Italy;* Moore, *Development and Character of Gothic Architecture;* Viollet-le-Duc, *Dictionnaire raisonné de l'architecture française;* Chateau, *l'Architecture en France;* Parker, *Introduction to the study of Gothic Architecture;* or *A B C of Gothic Architecture;* Paley, *Gothic Mouldings.* In Course 1*c* — Burckhardt, *Geschichte der Renaissance in Italien; Der Cicerone;* Symonds, *The Renaissance in Italy;* Anderson, *Architecture of the Renaissance in Italy;* Lübke, *Die Renaissance in Frankreich; Geschichte der deutschen Renaissance;* Muentz, *Histoire de l'Art pendant la Renaissance;* Blomfield, *The History of Renaissance Architecture in England;* Blomfield and Thomas, *The Formal Garden in England.*

ARCHITECTURE 2*a*. — Elementary Architectural Drawing. — The Orders. Professor H. L. WARREN and Mr. SWAN.

This course is illustrative of Course 1*a*, and is open only, except by special permission, to those students who are taking Course 1*a* in the same year. It may be counted for the degree of A.B. when taken together with Course 1*a*.

The drawing-room is open to students from 9 A.M. to 6 P.M. and on three evenings a week until 10 P.M. An instructor is usually present during the day-time. Students of architecture in their first year should give all their spare time to their drawing.

After some preliminary work the time is chiefly devoted to making a series of carefully rendered drawings of simple buildings, or portions of buildings, and of standard examples of each of the orders. This not only gives the necessary practice in draughtsmanship, but familiarizes the student with the best forms of the orders and is a preparation for Architecture 4*a*. Students are encouraged to make their own selection of the examples to be drawn, subject to the approval of the instructors. The drawings form in effect a series of illustrations to the lectures in Course 1*a*. An exhibition is made of each series of plates as completed, and the work is then criticised before the class. The course includes thorough drill in the elements of architectural form by means of blackboard exercises, smaller plates, and exercises in simple design from dictation. For students in Landscape Architecture the course is modified to include practice in the special kinds of draughtsmanship required by landscape architects.

ARCHITECTURE 2*b*.— Descriptive Geometry.— Stereotomy; Shades, Shadows, and Perspective. Mr. MOWLL.

This course is open to students who have passed satisfactorily in Architecture 2*a*.

It considers first the principles of Descriptive Geometry as applied to problems in the projection, intersection, and development of geometrical forms, such as occur in architectural practice, which cannot be solved by the ordinary processes of projection drawing. These principles are then applied to problems in stereotomy or stone-cutting and to shades and shadows.

In Stereotomy, drawings are made of various forms of arches, niches and vaults with working details of the separate stones. In Shades and Shadows, special attention is given to the shorter practical methods, and the subject is so studied as to give familiarity with the forms of the shades and shadows of architectural details of most frequent occurrence. In Perspective, after exercises which familiarize the student with its fundamental principles, practice is given in the practical methods of laying out perspectives which are in general use among architectural draughtsmen.

Text-books: Siebert and Biggin's *Modern Stone Cutting and Masonry;* Millard's *Shades and Shadows;* Longfellow's *Applied Perspective.*

ARCHITECTURE 3*a*. — Freehand Drawing. Messrs. MOWLL and SWAN.

This is a course for practice in freehand drawing especially arranged for students of Architecture and Landscape Architecture, in continuation of Fine Arts 1. It includes practice with pencil, pen, and brush, giving the student a careful training in the simplest methods of expressing a subject, whether a fragment of detail or a building.

ARCHITECTURE 3*b*. — Freehand Drawing (second course). Mr. H. B. WARREN, assisted by Mr. SWAN.

In this course the student is permitted more freedom, and individuality in the handling of his subject is encouraged. The works of the best draughtsmen are put before him, and after the severer training of the preceding course he may treat his subjects in his own way under the direction of the instructor, always with a view to producing a pleasing composition in light and shade, as well as in form.

ARCHITECTURE 3*c*. — Freehand Drawing from Architectural Subjects (third course). Mr. H. B. WARREN, assisted by Mr. SWAN.

Especial attention will be given in this course to the composition of drawings, which is not only essential to the artistic presentation of architectural subjects, but is of great aid in cultivating the sense of composition in architectural design, which depends upon the same principles. Studies principally from Turner, Constable, Harding, Cotman, and Prout will be carried on. In the latter part of the course instruction will be given in figure-drawing, casts from the antique and from mediaeval and renaissance masters being used as models.

These courses give the necessary daily practice in freehand drawing, which alone will enable the student of Architecture to obtain the knowledge of form and facility in its representation which an architect needs. Instruction is given in the use of pencil, pen, and water-colors. Work will be done from the flat and from the round. The increasing collection of examples of good draughtsmanship, which the department possesses, and the photographs and casts will be used as models. Nearly all the work will be done from architectural subjects, so that the student may be adding to his store of knowledge of architectural form at the same time that he acquires mastery of hand.

ARCHITECTURE 4*a*. — Elementary Architectural Design. — Practice and Criticism. Professor H. L. WARREN and Mr. MOWLL.

This course is open to those students only who have passed satisfactorily in Architecture 1*a* and 2*a*, or satisfy the instructors that they have done equivalent work. *All the courses in design will require the student to devote all the time he can possibly give to the work.* The drawing-room is open from 9 A.M. to 6 P.M., and on three days of the week until 10 P.M., and an instructor is usually present in the day-time. During the first weeks of the course the student will be occupied in making carefully rendered drawings of standard examples of architectural composition and in frequent exercises in design from dictation; in this way the memory and imagination of the student will be stimulated, and the knowledge of form acquired during the first year will be made use of and fixed in the mind. Following this introduction the study of architectural design will be further pursued (1) by means of occasional lectures on the principles of design and of planning, and (2) by means of problems of an elementary nature which will be given out from time to time as exercises in original composition. These designs will be carefully elaborated under the constant direction and criticism of the instructors, and when completed will be criticised before the whole class. For students in Landscape Architecture a section of this course will be provided in which particular attention will be given to planning the general arrangement of buildings and the composition of masses (subjects to which students in architecture devote more attention in the next following course), so that the student may be enabled to appreciate the relation which should exist between the composition of a building and the treatment of the grounds immediately about it and may be led to regard the two as integral parts of one design. The form and position of terraces, gardens and approaches will be considered in their relation to buildings.

ARCHITECTURE 4*b*. — Architectural Design (second course). Professor H. L. WARREN and Mr. MOWLL.

This course is open to students who have passed satisfactorily in Course 4*a*, of which it is a continuation.

As in the previous course, the work will be carried on by means of problems and criticisms, and occasional lectures. The study of planning will be taken up systematically, and lectures will be delivered on the right artistic treatment of the various materials used in building.

In the work in design the forms of classical architecture will be mainly used, as the object of the course is to give a mastery of technique and of composition, and this can better be done by endeavoring to secure as complete a mastery of one style as the limited time of the course will allow rather than by scattering the energies in an impossible attempt to secure adequate knowledge of several styles. For this purpose the classical styles are preferred, because of the simplicity of their fundamental forms and because these forms lie at the foundation of all modern styles. Some exercise in historic design in other styles will be given. The problems proposed in the courses in design will be selected with a view to stimulating as far as possible whatever imagination or poetic feeling the student may possess at the same time that they give practice in various classes of architectural composition. In the main they will be such as depend upon present American conditions: not merely conventional school problems without relation to our time or civilization.

In carrying on the work of this course the department is assisted in some of the problems by the architects who are members of the Committee appointed by the Board of Overseers.

ARCHITECTURE 4*c*. — Architectural Design (third course). Professor H. L. WARREN and Mr. MOWLL.

This course is open to students who have passed satisfactorily in Course 4*b*. The method of instruction will be the same as in the previous course. It will include the study of the planning and arrangement of important buildings. The second half of the year will be devoted to the making and complete presentation of a design for some important structure, which will be presented as a thesis.

ARCHITECTURE 5. — Building Construction: Carpentry. — Lectures and drawing. Mr. SWAN.

A careful study is made in this course of the framing of simple structures, such as an ordinary framed house, and of the details of carpentry construction. The joints of timbers in floors and roof trusses, the construction of window and door frames, wooden staircases and the like receive full consideration.

ARCHITECTURE 6. — Practice in modelling architectural ornament in clay. Mr. GARBUTT.

ARCHITECTURE *7a.* — Theory of Pure Design, Balance, Rhythm, and Harmony. Lectures, with experimental practice and study of examples. A course for the exercise and development of the aesthetic faculty. Dr. ROSS.

This course may be counted for the degree of A.B.

The spot of paint as a term of expression. Its tone, its measure, its shape. Thinking in tones, measures, and shapes. Expression of the thought by painting.

Pure Design: the composition of tones, measures, and shapes, for the sake of Rhythm, Balance, Harmony, the principles of Order, of Beauty. Definition and explanation of these principles. Exercises in designing. Study of color-values, or tones. The practice of tone-relations. Tone-balances, tone-rhythms, harmony of tones. Pure Design compared with Music. Appeal of Music to the ear, of Pure Design to the eye. The undeveloped possibilities of Pure Design.

Design in Representation. The object as represented by the visual image. Advancement of knowledge (science) by the definition of the mental image, as hypothesis, and by the comparison of the definition with the object (the facts of observation). The advancement of knowledge not necessarily an advancement of Art. Artistic representation; knowledge in forms of design. Importance of design in connection with Representation. Practice in Representation following the principles of Design.

The history and development of the Fine Arts. Painting particularly described. Painting in the East (China and Japan) and in Western Europe. Different modes of Pure Design and of Design in Representation. Study of examples and illustrations.

Object of the course: the development of the sense of Beauty and of the power of Imagination.

LANDSCAPE ARCHITECTURE.

Landscape Architecture 1. — Principles of Landscape Architecture. — Professor Olmsted, and Mr. Pray, with occasional lectures by Professors Goodale and Shaler.

This course is open to students of Harvard College who satisfy the instructors of their fitness to pursue it and may be counted for the degree of A.B.

The object of this course is to give the students a broad knowledge of many types of landscape and garden forms, of the elements which make up the quality of each, of the motives which underlie them when of artificial creation, of their limitations, and of the constant adaptation of means to ends in all good work. The instruction is in the form of lectures, supplemented by collateral reading, by informal conferences and by frequent exercises in writing or drawing for the purpose of impressing the instruction upon the students and assuring the instructor that he is understood. The types of landscape and garden design are taken up in the historical order of their highest development, but in addition to the critical description of historical examples with the aid of plans, drawings and photographs, reference is made whenever possible to actual examples, illustrative of the same principles, to be found in the vicinity of Boston. Students are expected to visit these examples and to make reports upon them.

In connection with this course the relation of landscape to geological structure, to climatic conditions and to vegetation, and the relation of both formal and informal design to natural limitations, will be set forth in a series of lectures by Professors Goodale and Shaler.

Landscape Architecture 2. — Practice in Landscape Design (first course). Professor Olmsted, and Mr. Shurtleff.

Landscape Architecture 3. — Practice in Landscape Design (second course). Professor Olmsted, and Mr. Pray.

Courses 2 and 3 are open only to those students who have passed satisfactorily in Course 1, in the Landscape section of Architecture 4*a*, and in Engineering 4*a*, or satisfy the instructors that they have done equivalent work. The two courses are to be taken in successive years and form in effect a single course extending over two years and requiring the student to devote the chief part of his time and attention to the subject. One or both of the instructors will be present on Mondays, Wednesdays, and Fridays from 1.30 to 4.30 P.M., and occasionally in the morning, but the drawing room is open every day from 9 A.M. to 10 P.M. and the students are expected to make diligent use of their time between conferences with the instructors. The work consists chiefly of the study of actual works and of the solution by the students of actual problems presented to them in definite form by the instructors. So far as is practicable, land in the vicinity of Cambridge is chosen for study and treatment, so that the student may have practice in that nice adjustment of plan to natural conditions which is one of the essentials of good work. The students are given practice in devising somewhat detailed construction plans for the more important portions of each of the general plans which they prepare. In the conduct of these courses, except for occasional lectures upon principles applying to the work in hand and frequent criticism of plans before the class as a whole, the conditions are made to approximate those of actual office practice as closely as possible. The elaboration of planting plans in connection with the general plans prepared in these courses is included in Horticulture 2 and 3, but the work is so arranged that the two sets of courses keep in close touch. In the latter part of Course 3, the work of the student is devoted chiefly to the preparation of a thesis, involving both a written report and plan, upon a subject approved by the instructors.

FORESTRY.

FORESTRY 1. — Silviculture. — The characteristics of forests; the forest regions of the United States; special consideration of trees important in forestry; the treatment of forests; methods of reproducing forests; tree planting. — Lectures, with additional hours for field work. Mr. R. T. FISHER.

In the field work of this course, excursions will be made at least once a week to tracts of forest in the neighborhood of Cambridge, where students can be given practice in making forest descriptions, studies of the habits of local species of trees, and reproduction cuttings, thinnings and other sorts of improvement cuttings. Part of the work, devoted to forest planting, will be taken up in the second half-year.

FORESTRY 2. — Forest Measurements. — Methods of computing the contents of felled and standing trees and of whole stands; the estimation of timber; the use and construction of American log scales; determination of diameter, height, and volume increment. —Lectures, with additional hours for field and laboratory work. Mr. CARTER.

The instruction in forest measurements will consist partly in lectures, and partly in practical work, either in the woods or in the laboratory.

Methods of estimating standing timber, the use of American log scales, the determination of the contents of single trees, whole stands, and of their rates of growth, and the construction of tables of yield, will be illustrated by actual problems in the field. Practice will also be given in the construction of rough forest maps and the determination of area without the aid of instruments.

FORESTRY 3. — Forest Botany. — Lectures, with additional hours for field work. Mr. JACK.

This course will comprise the study of trees and shrubs, particular attention being given to those of the Eastern states. The identification of woody plants (trees and shrubs) by external features, both in their summer and winter aspects, will receive special consideration, so that the student may learn means of distinguishing the useful and also less valuable species of trees and shrubs at all seasons of the year and different stages of growth. Chiefly Eastern species will be taken as types for study, but the principal trees of economic importance in North American forestry will be considered in regard to their botanical characteristics, geographical ranges and relative values. In addition to the lectures exercises will be given by field observations of local species, and some time will be given to work in the laboratory upon the study of the less conspicuous characters useful in the identification of woody plants.

FORESTRY 4. — Forest Protection. Mr. FISHER.

Discussion of injuries or encroachments from trespass, fire, wind, floods, shifting sand, insects, fungi, and grazing. Protective measures. Consideration of the forest laws of the United States, of the several states, and of the provinces of Canada.

FORESTRY 5. — Forest History. Mr. CARTER.

The course is designed to give the student a general idea of the forest administration of the chief countries of the world, from the point of view of historical development. Important aspects of management, forest laws, and the various silvicultural systems will be taken up, so that the student may understand the relation between the present forest policy of foreign countries and that of the United States. Special attention will be given to the establishment and organization of the Federal Forest Reserve System.

FORESTRY 6. — Lumbering. Messrs. CARTER and FISHER.

The lectures in this course will take up the lumber industry in various typical regions of the United States, logging, transportation, incidental construction, the manufacture of lumber and pulp, and secondary products. An important part of the instruction will be a report upon a selected lumber camp, which the student will be required to visit and study during the winter term of the final year's work.

FORESTRY 7. — Forest Management. — Lectures, with additional hours for field work. Messrs. FISHER and CARTER.

Forest management will deal with the economic principles governing the management of forest property. It will consider the normal forest as conceived in Germany, the study of forest production as applied in Europe, Asia, and America, the computation of the value of forests, the financial results of forestry, and the methods, based upon these considerations and the practice of important European countries and of India, of preparing forest working plans.

The field work will include reports upon special areas of forest and the determination of their value, and in the spring term the construction of a working plan for some large tract of forest.

MUSIC.

MUSIC 1. — Harmony. Asst. Professor SPALDING.

The fundamental principles of the theory of music are embodied in the study of harmony, which treats of the different chords in their natural relations and combinations. The subdivisions of the subject are as follows: Intervals, or the measurement of the difference in pitch between one tone and another; Triads, Seventh, and Ninth chords with their inversions and resolutions; Chromatically altered chords; Cadences; Suspensions; Passing and Changing-Notes; Organ-Point; Harmonization of given melodies, or the application of chords to the accompaniment of a *cantus firmus* in four-part writing; Modulation.

The work consists chiefly of written exercises on basses (both figured and unfigured) and the harmonization of given melodies; these are corrected by the instructor out of the class-room and subsequently discussed with the students individually. Exercises are also worked out on the blackboard by the students.

Prout's *Harmony* and Chadwick's *Harmony* are used as the basis of the instruction. The treatises of Jadassohn and of others are used as reference books, and supplementary illustrations and explanations are given in the class-room. The course is open and specially recommended to Freshmen.

ENGINEERING.

Engineering 1*a*. — Algebra. Asst. Professor Love, Mr. Frizell, and Dr. E. V. Huntington, and Mr. A. E. Norton.

Some of the topics studied are : theory of quadratic equations, binomial theorem, theory of equations, simultaneous equations, coördinates, trigonometric ratios, undetermined coefficients, partial fractions, infinitesimals, inequalities, variables and limits, series and convergency.

The *text-book* will be announced at the beginning of the course.

Engineering 1*b*. — Trigonometry. Asst. Professor Love, Mr. Frizell, and Dr. E. V. Huntington.

The topics treated will include the trigonometric ratios and their properties, solution of triangles, radian measure of angles, logarithms, trigonometric equations and identities, and the right spherical triangle with some of the applications of these subjects.

The sections meeting during the first half-year are intended for students of Architecture and Landscape Architecture, for those who have passed advanced Algebra for admission, and for others who can take this course more conveniently during the first half-year.

Text-book : Ashton's *Plane and Spherical Trigonometry and Tables.*

Engineering 1*d*. — Analytic Geometry. Asst. Professor Love, Mr. Frizell, Dr. E. V. Huntington, and Mr. A. E. Norton.

This course is open to students who have passed satisfactorily in Course 1*a* or its equivalent, and who take or have taken Course 1*b*.

The work will include a study of the straight line, the circle, the ellipse, the parabola, the hyperbola, and other important plane curves. Both rectangular and polar coördinates will be used.

Text-book : Ashton's *Analytic Geometry.*

Engineering 1*c*. — Differential and Integral Calculus. Asst. Professor Love, Mr. Frizell, Dr. E. V. Huntington, and Mr. A. E. Norton.

This course is open to students who have passed satisfactorily in Course 1*d*, or its equivalent.

Some of the topics treated in this course are differentiation, anti-differentiation, integration, and their applications to tangents, normals, areas, volumes, lengths, surfaces, curvature, evolutes, maxima and minima, indeterminate forms, development in series, computation by series, centres of gravity, moments of inertia, and motion. Partial differentiation and multiple integration will be treated briefly and applications made to problems in geometry and mechanics. Some time will be given to the elements of Solid Analytic Geometry.

The *text-book* will be announced at the beginning of the course.

ENGINEERING 3*a*. — Mechanical Drawing. — Use of Instruments. — Projections and Machine Drawing. Asst. Professor KENNEDY, Messrs. A. E. NORTON, ROSS, and ALDEN.

This course is introductory and is prescribed for all candidates for a degree in Engineering.

It is intended to supply a good working knowledge of the elements of mechanical and freehand projection drawing, and of their applications to the representation of machinery and other engineering structures. It also serves as an introduction to Descriptive Geometry and other courses requiring a knowledge of drawing. At the end of the course, students are expected to understand and to read mechanical drawings and to have some facility in the measurement and delineation of machines and structures. Particular attention is paid to rapid freehand work made as nearly as possible to scale.

The topics of the course in the order in which they are taken up are as follows. During the first half-year: the use of instruments; problems in geometrical drawing; orthographic and isometric projections; tracing and blue printing; and the practice of freehand sketching and lettering. During the second half-year: working drawings of machines and structures with a continuation of freehand sketching; the stretching of paper and practice in india-ink and color tinting.

Reference-books: Anthony's *Mechanical Drawing* and *Machine Drawing*.

ENGINEERING 3*b*. — Descriptive Geometry. — Elementary Shades, Shadows, and Perspective. — Lectures and draughting. Mr. MOYER.

This course is open to students who have passed satisfactorily in Course 3*a* or in Architecture 2*a*.

It consists mainly of the application of the principles of Descriptive Geometry to problems in the projection, intersection, and development of geometrical forms of common occurrence in Engineering and Architecture which cannot be solved by the ordinary processes of projection drawing. It also includes problems in shades and shadows, and in perspective, the general theories of these subjects being given with their application to simple forms.

Text-book: Moyer's *Descriptive Geometry*.

ENGINEERING 3*d*. — Mechanism. — Study of gearing and mechanical movements. Asst. Professor KENNEDY and Mr. A. E. NORTON.

This course is open to students who have passed satisfactorily in Course 3*a*.

In this course the transmission and change of motion by means of toothed wheels, link work, belts, and special devices are taken up in both their theoretical and practical aspects. Problems involving these different modes of transmission are worked out in the draughting-room, particular attention being paid to the construction of teeth of wheels by exact and approximate methods. Analyses of simple machinery and calculations for trains of wheel work, belting, etc., are made in order to give the student thorough grounding in the principles of pure mechanism.

Reference-book: Barr's *Kinematics of Machinery.*

ENGINEERING 4*a*. — Surveying. — Use of Instruments. — Plane and Topographical Surveying, Topographical Drawing and Levelling. — Field practice. Asst. Professor H. J. HUGHES and assistants.

Course 4*a* is open to students who have studied Plane Trigonometry. See note under Course 4*d*.

The work of this course consists of the study of the theory and adjustments of the several surveying instruments, together with their practical use in the field. The field surveys consist of differential and profile levelling; chain, compass, and transit land surveys; cross-section, transit and stadia, and plane-table topographical surveys; and laying out simple curves. From the field-notes necessary computations are made and the surveys mapped.

Text-book: Raymond's *Plane Surveying*, and Pence and Ketchum's *Surveying Manual.*

Reference-books: Baker's *Engineering Instruments;* Johnson's *Theory and Practice of Surveying;* Gannett's *Topographical Surveying.*

ENGINEERING 4*c*. — Geodetic Surveying. — Field work of triangulation. — The use of astronomical instruments in Surveying and Navigation. Asst. Professor H. J. HUGHES and assistants.

This course is open to students who have passed satisfactorily in Course 4*a*. Some spherical trigonometry is also desirable.

The course includes the methods of measuring base lines with special reference to the use of the steel tape, of observing angles, adjusting angle observations, determining absolute positions, adjusting triangulations, trigonometrical levelling, precise spirit levelling, and of projecting maps.

Text-book: Merriman's *Geodetic Surveying.*

Reference-books: U. S. Geodetic Survey Reports; Johnson's *Theory and Practice of Surveying;* Wilson's *Topographical Surveying.*

ENGINEERING 4*d*. — Railroad Engineering (first course). — Survey, location, and construction of railroads. Field practice. Asst. Professor H. J. HUGHES and assistants.

Course 4*d* is open to students who have passed satisfactorily in Course 4*a*.

The course includes a study of the principles necessary to enable the engineer to select a route for a railroad, to determine the necessary grades and curves, to solve the problems incident to the location of the line upon the ground, to compute the quantities in excavation and embankment, and finally to lay the track in place. The students survey a line about eight miles long, take the topography, make a map location, adjust the location to the ground, compute the cost, and stake out the line as for actual construction.

Text-book: Webb's *Railroad Construction, Theory and Practice.*

Reference-books: Searle's *Field Engineering*, and *Spiral;* Tratman's *Railway Track and Track Work;* Camp's *Notes on Track;* Crandal's *Transition Curve.*

Courses 4*a*, 4*d*, and 4*c* follow in the order named during the same summer.

Course 4*a* may be counted as one course, and Courses 4*d* and 4*c* if taken together may be counted as one course, towards the degree of A.B.; but neither Course 4*c* nor Course 4*d* may be counted if taken separately.

These courses are prescribed for students of Civil Engineering, and Course 4*a* is strongly recommended also for students of Mechanical and Electrical Engineering.

ENGINEERING 4*e*. — Road Making and Maintenance. Professor OLMSTED, Asst. Professor HUGHES, and Mr. PRAY.

Course 4*e* is open to students who have taken a course in Surveying. It is part of the required work of students of Civil Engineering and of Landscape Architecture, and it can be counted towards no degree except the S.B. in Civil Engineering and the S.B. in Landscape Architecture.

Instruction will be given, by lectures, in the location, construction, and maintenance of roads adapted to various uses, and under various conditions, both for commercial and pleasure purposes. Alignment, grade, drainage, foundation, surfacing, and necessary details will be considered.

In addition, the students will make a location survey for a road, and using this as a basis, they will be taught how to make plans, to write specifications, to estimate the cost of construction, and to lay out work from plans.

ENGINEERING *4f.* — Railroad Engineering (second course). — Problems in railroad construction and maintenance. Asst. Professor H. J. HUGHES.

Course *4f* is open to students who have passed satisfactorily in Course *4d.*

This course is a continuation of the first course in Railroad Engineering, taking up in detail the principles which fix lines and grades. Practice will be given in making preliminary estimates. The economical use of materials for new construction and for maintenance, switches, frogs, crossings, signals, yard arrangements and other important details will be investigated. In the same manner, the principles of street railway building will be studied.

ENGINEERING *5a.* — Applied Mechanics. Professor HOLLIS and Mr. ROSS.

Course *5a* is open to students who have passed satisfactorily in Courses 1*c* and *5b* or their equivalent.

This course is a continuation of the elementary courses in mechanics, Engineering 5*b* and 5*e*. The first term is wholly given up to the application of the principles of mechanics to machinery, including the steam engine and other motors. During the second term, instruction in resistance of materials is begun and completed for the general student. The treatment of this subject is fundamental and general in its nature, leaving to the Senior year extended applications to machinery, buildings, and bridges. Some attention is given to tests of materials and to the relation of test pieces to full-sized members. The subject is taught mainly by means of lectures and numerous exercises.

Reference-books: Rankine's *Applied Mechanics;* Cotterill's *Applied Mechanics;* Jamieson's *Applied Mechanics;* Perry's *Applied Mechanics;* Burr's *Elasticity and Resistance of Materials of Engineering;* Johnson's *Materials of Engineering.*

ENGINEERING *5b.* — Elementary Statics. — Graphic and Alegbraic Methods. Asst. Professor JOHNSON and Mr. MOYER.

This course is open to students who have passed satisfactorily in Course 1*b* or its equivalent. It is also given in the summer at the Squam Lake Camp.

This course is devoted to the study of Statics with special reference to a thorough grounding in the fundamental principles.

The instruction includes lectures, the solution of selected and graded problems (drawn mainly from engineering practice), and regular conferences between instructors and students.

Algebraic and graphic methods are developed with equal thoroughness, and, in general, each problem is solved by both methods.

The problems of the course include the investigation of the stability of structures, and the calculation of stresses in simple trusses and structures.

Text-book: Johnson's *Statics by Algebraic and Graphic Methods.*

ENGINEERING 5*c*. — Resistance of Materials (second course). Professor HOLLIS.

Course 5*c* is open to students who have passed satisfactorily in Course 5*d*.

The course in Resistance of Materials is designed to give the student a comprehensive knowledge of the nature of materials used in Engineering construction, including the laws of their behavior under stress, both above and below the elastic limit. Some attention will be given to commercial tests and the relation of the test pieces to the members of engineering structures. The subject will be taught by means of the mathematical theory of elasticity of materials.

Reference-book: Burr's *Elasticity and Resistance of Materials of Engineering.*

ENGINEERING 5*d*.—Resistance of Materials (introductory course).— Elementary Structural Design. Mr. MOYER.

Course 5*d* is open to students who have passed satisfactorily in Course 5*b*. It is intended for students of Architecture. It is also given in the summer at the Squam Lake Camp.

After a brief exposition of the fundamental principles of Resistance of Materials, the work of the course is directed towards practice in the application of these principles to the simple problems constantly met in structural practice. Each student is required to solve a large number of problems in such a way as to encourage habits of speed and correctness in computation as well as to gain familiarity with the subject. These problems involve the prominent features of the design of wooden and steel beams, girders, footings, columns, and wooden and combination roof-trusses, etc.

Reference-books: Johnson's *Materials of Construction;* Freitag's *Architectural Engineering;* steel manufacturers' handbooks.

Engineering *5c.* — Elementary Kinematics and Kinetics and problems in Statics. Asst. Professor Johnson and Mr. Moyer.

Course *5e* is open to students who have passed satisfactorily in Course *5b* or its equivalent, and in the first half of Course 1*c* or its equivalent.

Course *5e* cannot be taken by a student who takes or has taken Mathematics 4.

This course follows Course *5b*, and for a short period forms a continuation of it. This period is devoted to practice in the application of Statics to some of the more important special engineering problems.

The remainder of the course is devoted to the treatment of the fundamentals of Kinematics and Kinetics. The instruction includes occasional lectures with a large amount of problem work and regular conferences between instructors and students.

Engineering *6a.* — Hydraulics and Hydraulic Motors. — Flow of water in pipes. — Water wheels, turbines, and pressure engines. Asst. Professor H. J. Hughes.

Course 6*a* is open to students who take or have passed satisfactorily in Course 5*a* or Mathematics 4.

The first part of the course is devoted to the study of the general theory of Hydraulics, which is applicable to all branches of Hydraulic Engineering, including, among other things, the discussion of the laws governing the flow of water through orifices, over weirs, through tubes, and through pipes. The second part of the course is a study in the theory and practice of hydraulic motors.

Text-book: Merriman's *Hydraulics.*

Reference-books: Hamilton Smith's *Hydraulics;* Francis's *Lowell Hydraulic Experiments;* Bodmer's *Hydraulic Motors;* Bovey's *Hydraulics.*

Engineering *6c.* — Water Supply and Sanitary Engineering. Asst. Professor H. J. Hughes.

Course 6*c* is open to students who have passed satisfactorily in Course 6*a*. It cannot be counted towards the degree of A.B.

The considerations necessary for the complete design of water-supply systems by gravitation, pumping, and ground storage, from the survey of the water-shed to the delivery into the house, are taken up in detail.

The effects of soil on water, and the importance of the geological character of the water-shed, as well as the conditions affecting the plan of storage and determining the supply, are all considered.

The pollution and filtration of potable waters, and the whole subject of sanitary engineering, including the utilization and disposal of sewage, are treated in the light of the latest experience.

Text-books: Turneaure and Russell's *Public Water Supply*, Folwell's *Sewerage.*

ENGINEERING 6*d*. — Canals, Rivers, and Harbors. — Irrigation. — Measurements of the flow of water. — Lectures and laboratory work. Asst. Professor H. J. HUGHES.

Course 6*d* is open to students who have passed satisfactorily in Course 6*a*. The course includes the study of rain-fall, evaporation, flow-off from the catchment area, methods of measuring river discharges with field work, the laws governing the flow in rivers, and the methods of river improvement; the discussion of the theory of the flow in canals, and the methods of constructing canals; the solution of the problems pertaining to irrigation engineering, such as the location and construction of canal head and regulating works, of control and drainage works, and of laterals and distributaries.

ENGINEERING 7*a*.—Bridges and Buildings.—Design of Framed Structures. Lectures and draughting. Asst. Professor JOHNSON.

Course 7*a* is open to students who have passed satisfactorily in Course 5*d* and 5*a* or their equivalent. It cannot be counted towards the degree of A.B.

The course is intended to give systematic training in the principles and methods involved in the economical design of wood, steel, and steel-concrete structures, such as roofs, bridges, and buildings.

The course opens with a study of methods of determining extreme stresses in structures subject to varying and moving loads. In this work, both graphic and algebraic methods will be freely used. Subsequently each student works out designs of typical structures of moderate size. Special attention is given to encouraging business-like methods of making and recording computations. Students make working drawings of their projects, taking no more time for such work than is needed for suitable presentation of their designs, and for some practice in expressing their ideas clearly and in detail by drawings.

Special problems which arise in connection with structures other than those designed in detail by the student are taken up in lectures and exercises. In this work, a prominent purpose is to train the student to make prompt and correct application of general principles already familiar to him.

Such knowledge of rolling-mill, shop, and erection practice as is needed for a clear understanding of the requirements of good design is obtained from manufacturers' handbooks, from visits to neighboring bridge works, and to bridges and buildings in course of construction, and from lectures.

The *text-book* will be announced at the beginning of the course.

Reference-books: Johnson, Bryan, and Turneaure's *Theory and Practice of Modern Framed Structures* (latest edition); Merriman and Jacoby's *Roofs and Bridges;* Wright and Wing's *Bridge Drafting;* Johnson's *Materials of Construction;* steel manufacturers' handbooks.

ENGINEERING 8*a*. — Building Stones, Masonry, and Foundations. Professor WOLFF and Asst. Professor JOHNSON.

Course 8*a* should be preceded by Engineering 5*d* or its equivalent. It cannot be counted towards the degree of A.B.

In this course a study is made of the materials used in masonry and foundations, such as stone, brick, lime, cement, concrete, and timber, with reference to their physical properties, methods of preparation, cost, and their proper application to structures. The fireproof construction of buildings is a prominent topic in this part of the course.

The different systems of foundations are also described and discussed with reference to their comparative merits and proper fields of application. Some leading topics in this part of the course are piles, and pile-driving, coffer-dams, open caissons, pneumatic work, and open crib work.

The course includes also a brief description of the principal features of tunnelling.

Reference-books: Merrill's *Stones for Building and Decoration;* Baker's *Masonry Construction;* Freitag's *Architectural Engineering;* Freitag's *Fireproofing;* Kidder's *Building Construction;* Patton's *Foundations;* Drinker's *Tunnelling;* Johnson's *Materials of Construction;* Degrand et Résal, *Ponts en Maçonnerie*.

ENGINEERING 10*a*. — Chipping, Filing, and Fitting. — Use of hand-tools. — Fitting by hand. — Study of the metals in practical working. — Lectures and laboratory work. Asst. Professor BURKE and Mr. MARKHAM.

See note under Course 10*e*.

ENGINEERING 10*b*. — Blacksmithing. — Use of tools. — Forging, welding, tool-dressing and tempering. Lectures and laboratory work. Asst. Professor BURKE and Mr. MARKHAM.

See note under Course 10*e*.

ENGINEERING 10*c*. — Pattern Making and Foundry Practice. — Use of wood-working tools. — Casting in iron and alloys. — Lectures and laboratory work. Asst. Professor BURKE and Mr. MARKHAM.

See note under Course 10*e*.

ENGINEERING 10*e*. — Machine Shop Practice. — Use of machine tools. — Construction of parts of machinery; finishing and assembling parts. — Lectures and laboratory work. Asst. Professor BURKE and Mr. MARKHAM.

The courses in shopwork begin about June 16th and are completed in nine weeks. Courses 10*a* and 10*b* are given together during the first half of that period, and Courses 10*c* and 10*e* are given together during the second half. All four of these courses may be taken in one summer.

The four shopwork courses may be counted towards the degree of S.B. in General Science as the equivalent of one and one-half courses. They cannot be counted towards the degree of A.B.

These courses are at present conducted at the Cambridge Manual Training School, where there are complete facilities for the purpose. The laboratory work is supplemented by lectures and by visits to the workshops within reach of Cambridge. The aim of the courses is not primarily to give students manual skill, but rather the practical knowledge of materials and of the methods of manufacture necessary for the economical design of machinery and structures.

ENGINEERING 11*a*. — Steam Machinery (introductory course). Asst. Professor MARKS, Messrs. MARKHAM and TYNG.

Course 11*a* is open to students who are able to read mechanical drawings.

The course is devoted mainly to a general study of the more common forms of steam machinery. The different types of steam boilers, their construction, setting, operation, and maintenance are described and discussed. The subject of fuels, solid, liquid, and gaseous, including the devices in use for their economical combustion, receives attention. This is followed by a study of the construction and operation of the various forms of stationary engines. Compounding, governing, counterbalancing, the action of the fly-wheel, and the effects of the inertia of the reciprocating parts are treated in an elementary manner. The methods of action of the common forms of valves and valve gears are explained.

Visits of inspection to various machinery plants in the neighborhood are arranged.

ENGINEERING 12*a*. — Efficiency and Economics of Heat Engines. Asst. Professor MARKS.

Course 12*a* is open to students who have passed satisfactorily in Course 12*b*.

In this course heat engines are considered from the thermal standpoint. The sources of loss of efficiency in steam engines are individually analyzed and the methods of reducing the losses, by compounding, jacketing, superheating, and by other devices, are discussed. The effects of these losses on the cost of steam power and the considerations determining the choice of the type of steam engine to be used under any given conditions are treated. Gas and oil engines are similarly studied, and are compared with the steam engine. Other topics which are taken up include the theory and performance of air-compressing and refrigerating machines, and of steam turbines.

ENGINEERING 12*b*. — Elements of Thermodynamics. — Theory of Heat Engines. Asst. Professor MARKS and Mr. TYNG.

Course 12*b* is open to students who take, or have passed satisfactorily in, Course 13*a*.

The course is devoted to a study of the laws governing the transformation of heat into work, and the application of these laws to the processes in air, gas, steam, and other heat engines.

ENGINEERING 12*c*. — Heating and Ventilation. Asst. Professor BURKE.

Course 12*c* is open to students who have passed satisfactorily in Course 11*a*. It cannot be counted towards the degree of A.B.

The heating and ventilation of buildings receive the treatment necessary to supplement the instruction bearing on these topics given in other courses. Instruction in this course includes a consideration of the forms of hot-water and steam boilers, and hot-air furnaces; the sizes and leads of pipes for the distribution of hot water, steam, and hot air; the positions and proportions of radiators, and the practical details of installing heating plants. The use of exhaust steam is fully treated. About half the time is devoted to the consideration of the principles and details of distributing air for heating and ventilation by mechanical means. Central heating plants are discussed briefly. Each student is required to design a heating and ventilating plant for a large building.

ENGINEERING 13*a*.—Engineering Laboratory.—Introductory course in experimental methods. Asst. Professor MARKS, Messrs. MOYER and TYNG.

Course 13*a* is open to students who take, or have passed satisfactorily in, Courses 5*a*, 6*a*, and 11*a*.

The principal objects of the course are to give instruction and practice in the methods and with the instruments used in carrying out engineering investigations.

The laboratory work includes the calibration of various instruments, such as steam engine indicators, transmission and absorption dynamometers, and pressure gages; the determination of the efficiencies of hoisting gears, steam boilers, steam engines, pumps, gas engines, and water wheels; the investigation of the efficiency of the transmission of power by ropes and belts; the measurement of the friction of journals and of the flow of water through orifices and over weirs; the testing of the strength of wrought iron, steel, cast iron, wood, stone, brick and cement. Practice is also given in flue gas analysis, in the use of steam calorimeters, and in valve setting.

ENGINEERING 13*b*. — Engineering Laboratory (second course). — Lectures (*once a week*); laboratory work (*nine hours a week*). Asst. Professor MARKS and Mr. MOYER.

Course 13*b* is open to students who have passed satisfactorily in Course 13*a*, and are taking Course 12*a*. It cannot be counted towards the degree of A.B.

The work in this course consists of a series of investigations carried out by all the students and of a research on some special subject which may form the basis of, or may supplement, the student's thesis. The regular investigations include complete tests of a boiler, steam engines, gas engines, a hot-air engine, an air compressor, a blower, an injector, governors and other machines. Some investigations are also made on the transmission and radiation of heat, on the strength of materials, on lubricants and fuels, and the transmission of power. Tests of power plants will be made as opportunity offers.

ENGINEERING 14*a*. — Machine Design (introductory course). — Designing the parts of machinery. — Methods of proportioning the parts for strength and effect. Lectures and draughting. Asst. Professor KENNEDY.

Course 14*a* is open to students who have passed satisfactorily in Courses 3*d*, 5*e*, and 11*a*.

The course is intended to give practice in the design of simple machine details and some knowledge of the application of the principles of mechanics. Complete working drawings of machines and their details are made during the year; but the students are required to design a great many pieces of which only freehand sketches are kept. All of the latter work is done in note-books, which are carefully examined by the instructor, in order that habits of neatness and system as well as accuracy may be impressed upon students.

Text-book: Low and Bevis's *Machine Design*.

Reference-books: Reuleaux' *Constructor*; Kent's *Mechanical Engineer's Handbook*.

ENGINEERING 14*b*. — Machine Design (second course). — Study and design of steam machinery. Valve diagrams. Professor HOLLIS.

Course 14*b* is open to students who have passed satisfactorily in Course 14*a*. It cannot be counted towards the degree of A.B.

The designs of entire machines are undertaken in this course, with instruction in the details of the steam engine and boiler. It is expected that every student will complete the working drawings of the principal parts of a steam engine and of a steam boiler. Reference is freely made to the books and drawings in the library, and the student is required to study out the designs himself with only such aid from the instructor as may be needed to insure reasonable progress.

ENGINEERING 15*a*. — Marine Engines and Boilers. Professor HOLLIS.

Course 15*a* is open to students who have passed satisfactorily in Course 14*a*, and have fulfilled all the requirements for the first three years in Mechanical Engineering. It cannot be counted towards the degree of A.B.

This course is intended mainly as an alternative for Course 14*b* and it will be similar to it, relating however to a different class of problems. There will be a series of lectures on marine machinery and some of the elements of ship construction. Each student will be expected to design the engines and boilers for a given ship; and, if time permits, he will have the opportunity of making the plans of an entire ship.

ENGINEERING 16*a*. — Generation, Transmission, and Utilization of Electrical Energy (elementary course). Lectures and laboratory work. Professor KENNELLY, Messrs. WHITING and ANDEREGG.

Course 16*a* is open to students who have passed satisfactorily in Course 1*c* or its equivalent, and in Physics *C* or Physics 1.

It is intended primarily for students in Civil and Mechanical Engineering and in Mining who do not expect to carry the study of this subject farther.

The lectures begin with a review of the laws governing the flow of electric currents, the laws of electro-magnetic induction, and the magnetic circuit. These laws are then applied in the study of the more important types of apparatus for the measurement, generation, transformation, and utilization of electrical energy, — including arc and incandescent lamps, electric furnaces, primary and secondary batteries, direct and alternating-current generators, motors, and transformers, and apparatus for telephony and telegraphy.

In the latter part of the course the apparatus studied during the first part is assembled and brought into better perspective by means of descriptions of typical plants for the generation, transmission, and utilization of electrical energy.

The work in the laboratory follows the same general outline as the lectures. Beginning with a few elementary measurements in electricity and magnetism, the student takes up a brief experimental study of the above-mentioned types of electrical apparatus. During the latter part of the year occasional visits are made to some of the numerous interesting plants in the vicinity of Boston, and in each case a carefully written report is made.

The treatment of these subjects, in both lectures and laboratory, is of necessity elementary, but sufficient to give the student a general view of the field of electrical engineering, including a general familiarity with the characteristics and ranges of usefulness of the more important kinds of electrical apparatus.

Reference-books: Thompson's *Elementary Lessons in Electricity and Magnetism;* Jackson's *Elementary Electricity and Magnetism;* Sheldon's *Dynamo Electric Machinery;* Sheldon's *Alternating Current Machines;* Crocker's *Electric Lighting;* Bell's *Electric Power Transmission;* Abbott's *Electrical Transmission of Energy.*

ENGINEERING 16*c*. — Direct Current Dynamo-Electric Machinery. Lectures; laboratory work, Direct Current Machinery and Cable Testing. Professor KENNELLY.

Course 16*c* is open to students who have passed satisfactorily in Course 1*c* and in Physics 1 or *C*, or their equivalent.

This course is intended primarily for third-year students in Electrical Engineering.

The work begins somewhat as in Course 16*a*, but with a more thorough review of the elementary principles of electricity, magnetism, and electromagnetism, special attention being given to the magnetic circuit.

The theory of direct-current machinery is then carefully studied and illustrated by numerous problems. Armature winding and commutation receive considerable attention. In the laboratory the work begins with tests which illustrate and corroborate the theory, and then takes up complete commercial tests of this class of machinery.

Reference-books: Sheldon's *Dynamo Electric Machinery;* and S. P. Thompson's *Dynamo Electric Machinery.*

ENGINEERING 16*d*. — Dynamo Design. Mr. ANDEREGG.

Course 16*d* is open to students who take or have taken Course 16*e*. It cannot be counted towards the degree of A.B.

The work is carried on in the draughting room, with occasional lectures on the theory of design. Each student is expected to make designs of one direct-current constant-potential generator, one alternating-current generator, one alternating-current transformer, and one induction motor.

All electrical and magnetic dimensions are worked out and sketches made on section paper, and in the case of one of the machines designed by each student, large scale drawings are made.

Considerable reading is required.

Reference-books: Thompson's *Dynamo Design;* Kapp's *Dynamo Construction;* Parshall and Hobart's *Electric Generators* and *Armature Winding;* Arnold's *Die Gleichstrom Machine.*

ENGINEERING 16*e*. — Alternating Currents and Alternating Current Machinery. — Theory and testing. Letures and laboratory work. Professor KENNELLY and Mr. ANDEREGG.

Course 16*e* is open to students who have passed satisfactorily in Course 16*a*, 16*c*, Physics 3 or Physics 4.

The lectures begin with the theory of alternating currents, including the effects of inductance, capacity, and frequency, and then take up the study of apparatus for the generation, measurement, transformation, transmission, and utilization of such currents.

In the laboratory the first series of experiments is designed to familiarize the student with the effects of inductance and capacity in alternating current circuits, with the methods of measuring these quantities and with the magnitudes of their practical units. Then follow experiments on alternators, transformers, alternating-current motors, and synchronous converters, and other minor apparatus.

Reference-books: C. P. Steinmetz's *Alternating Current Phenomena;* Franklin and Williamson's *Alternating Currents;* Gisbert Kapp's *Transformers;* D. C. Jackson's *Alternating Currents and Alternating Current Machinery;* Oudin's *Standard Polyphase Systems;* and S. P. Thompson's *Polyphase Electric Currents.*

ENGINEERING 16*f*. — Electrical Engineering Laboratory. — Dynamo Testing; Electric Light Photometry; Storage Batteries; Electrochemistry. Laboratory work. Mr. WHITING.

Course 16*f* is open to students who have passed satisfactorily in Course 16*a*, 16*c*, or Physics 3. It cannot be counted towards the degree of A.B.

The course deals with a variety of special tests and investigations of which the following are illustrative: light distribution of electric lamps, capacity of batteries under varying discharge rates, electrolytic reduction from fused and dissolved salts, dielectric strength of insulating materials. Tests on electrical plants in commercial operation are made occasionally. The Standardization Rules of the A. I. E. E. and the National Electric Code are discussed and are made the basis of part of the work.

Reference-book: Foster's *Electrical Engineer's Pocket Book.*

ENGINEERING 17*a*. — Electrical transmission and Distribution of Power. Professor KENNELLY.

Course 17*a* is open to students who take, or have passed satisfactorily in, Course 16*e*.

The course deals with the principles of the electric transmission of power, both by direct and alternating currents. Special consideration is given to polyphase alternating-current machinery. The various applications of electric power transmission are discussed, together with the conditions of their effectiveness, economy, and efficiency. The various types of electric machinery employed in power transmission are analyzed, with especial reference to their capabilities for transforming or delivering power.

ENGINEERING 17*b*. — Telegraphy and Telephony. Professor KENNELLY.

Course 17*b* is open to students who have passed satisfactorily in Course 16*a*, 16*c*, or Physics 3.

The course deals with the main systems of electric telegraphy and telephony in practical use, with reference to their principles and modes of application. The various types of telegraph conductor are also taken up in detail, aerial, subterranean and submarine. The installation, maintenance and testing of telegraph and telephone lines are considered, as well as the difficulties encountered in their operation. Wireless telegraph systems are studied, and their methods of operation discussed.

ENGINEERING 21. — Conference on Engineering subjects (*two hours a week, usually in the evening*). — Students of Civil, Mechanical, and Electrical Engineering meet in separate sections.

Course 21 is part of the required work of fourth-year students of Engineering, and is not counted for other students towards the degree of S.B. It cannot be counted towards the degree of A.B.

The course is conducted mainly by students, and deals with current problems in Engineering, referring freely to transactions of engineering societies and to periodicals.

ENGINEERING 22. — Contracts and Specifications. — Principles of Common Law as applied to contracts. Asst. Professor WYMAN.

Course 22 is part of the required work of fourth-year students of Engineering and of Architecture, and is not counted for other students towards the degree of S.B. It cannot be counted towards the degree of A.B.

The course consists of about fifteen discussions, based upon various decisions of the courts. A book has been arranged by the instructor for this purpose, entitled *Cases on Engineering Contracts* (Little, Brown & Co., 1904).

Primarily for Graduates

COURSES OF RESEARCH

ENGINEERING 20*b*. — Heat Engines. Asst. Professor MARKS.

ENGINEERING 20*c*. — Dynamo-Electric Machinery. Professor KENNELLY.

Opportunity and guidance will also be provided for competent students wishing to pursue other lines of investigation.

These courses are intended primarily for Graduate Students who are candidates for the degree of S.M. in Engineering, but may be taken by others who are suitably prepared.

Each may count for one, two, or more full courses, but it is not deemed advisable to undertake any research course unless the time of at least two full courses can be devoted to it.

The work consists, first, of extensive reading and the preparation of a bibliography of the subject, by which the student is made familiar with all the important work done in the same line before; next, the planning and performance of the experimental part of the investigation; and finally, the preparation of a thesis on the subject, including a full account of the work done and a complete discussion of all the results.

THESIS.

Every thesis should consist of a complete investigation or design, containing, where possible, the results of personal and independent observation, and so limited in scope as to be capable of completion before the first of June.

The subject of the thesis should be selected as early as possible in the Senior year. It must be submitted to the Chairman of the Division before December 1, in order that it may have consideration at a meeting of the Division shortly after that date.

The Division will suggest the instructor under whose guidance the work should be prosecuted. After approval by the Division the subjects selected for theses, with the names of the investigators, will be posted in the Engineering Library for the remainder of the year.

Reports of progress and of the methods of investigation may be made and discussed in Engineering 21 during the second half-year.

The completed theses are to be presented before the first of June to the instructor under whose direction they have been prepared, and the students may be required to stand an examination on them or to read them at a meeting of the Division and class.

Attention must be paid to clear English and to a concise and accurate presentation of the subject. The theses will be bound and deposited in the Engineering Library for future reference.

All theses must be written (preferably typewritten) on paper of dimensions 8″ × 10½″, so that they may have uniform binding. Drawings and sketches necessary for explanation of the text must be folded to the size of the manuscript, with an edge left for binding.

PHYSICS.

Physics *B*. — Elementary Physics. Professor E. H. Hall, Dr. G. W. Pierce, and Mr. ——.

In 1904–05 students for whom Course *C* or Course 1 is prescribed may take Course *B* as a half-course.

The laboratory exercises of Course *B* are given in the morning hours.

Course *B* is substantially equivalent to the Elementary Physical Science of the requirements for admission. It is open to students who have not passed in this requirement or taken in College any course in Experimental Physics. It may be taken with Chemistry 1, although in the same examination group; for examination it is placed in Group I.

The object of this course is to enable every student to obtain practical acquaintance with laboratory methods of work, and with those elementary facts and laws which are the foundation of the science of Physics. It is for those who have done little or no laboratory work in Physics before coming to College, and is the natural introduction to Courses *C* and 1. Students are advised to take it in the Freshman or the Sophomore year. The book used is Hall and Bergen's *Text-book of Physics*, Holt & Co.

Physics *C*. — Experimental Physics. — Mechanics, Sound, Light, Magnetism, and Electricity. Asst. Professor Sabine, and Dr. H. W. Morse.

Course *C* is substantially equivalent to the Advanced Physics of the requirements for admission. It is intended for those who wish to give especial attention to methods of physical measurement in preparation for higher courses in Physics, Chemistry, or Engineering. The course is intended for students who have taken Course *B* or have offered Elementary Physics of the requirements for admission, but may be taken by others who satisfy the instructor of their fitness to profit by the course.

The manual used as a guide in the laboratory work is Sabine's *Laboratory Course in Physics*, Ginn & Co.

PHYSICS 1. — General Descriptive Physics. Professor E. H. HALL and Mr. ——.

Course 1 is intended for students who wish to become acquainted with a wide range of physical phenomena and with the means for exhibiting and applying such phenomena. It is intended for students who have taken Course *B* or who have passed in the second alternative of the Elementary Physics of the requirements for admission, but may be taken by others who satisfy the instructor of their fitness to profit by the course.

Hastings and Beach's *General Physics*, Ginn & Co., will be used as a text-book.

PHYSICS 2. — The Theory of Light in its application to familiar optical phenomena and to optical instruments. Asst. Professor SABINE.

Course 2 is open to students who have taken Physics *C* or Physics 1 or the equivalent, and have a knowledge of trigonometry.

Students taking this course are asked to provide themselves with P. G. Tait's *Light*, Lommel's *Nature of Light*, Hasting's *Light*, *and S. P.* Thompson's *Light, Visible and Invisible.* An examination of these books will give an idea of the nature of the course. As many as possible of the optical phenomena there discussed will be shown either by projection or by lecture table demonstration. The course will also cover atmospheric and other natural optical phenomena, and among optical instruments the more careful study will be given the telescope, microscope, and camera lens, with special reference to their aberrations and limiting values.

PHYSICS 3. — Electrostatics, Electrokinematics and parts of Electromagnetism. Professor B. O. PEIRCE and Dr. AYRES.

Course 3 is adapted to students who take or have taken Mathematics 2 or its equivalent, and should be preceded by Course *C* or 1.

The course consists of a lecture or recitation every Tuesday, with from six to eight hours of laboratory work per week. In the laboratory the student is expected to learn to make accurate absolute or relative measurements of current strength, resistance, electromotive force, quantity, and capacity. In the second half of the year such a knowledge of the principles of the Differential and Integral Calculus will be assumed as students who are then taking Engineering 1*c* or Mathematics 2 should have.

Students who elect this course are asked to provide themselves with S. P. Thompson's *Lessons in Electricity and Magnetism*, Part 2 of the *Physical Laboratory Notes of the Massachusetts Institute of Technology*, Day's *Examples in Electricity and Magnetism*, and a pamphlet published by the University containing a description of certain preliminary experiments in Magnetism. References will be made to other books to be found reserved in Gore Hall.

PHYSICS 4. — Electrodynamics, Magnetism, and Electromagnetism. Professor TROWBRIDGE, Dr. G. W. PIERCE, and Dr. THEODORE LYMAN.

Course 4 is intended for students who have taken Engineering 1*c* or Mathematics 2, or its equivalent, and Physics 3.

The lectures of this course treat of the magnetic properties of metals, the theory of the alternating current, the various methods of measuring self and mutual inductance, electric oscillations of high frequency, and the elementary theory of Hertzian waves.

The laboratory work embraces: Tests of the magnetic properties of iron and nickel by the magnetometer and ballistic galvanometer methods; measurements of self and mutual inductance by Maxwell's method, Rayleigh's method, commercial method, spark-discharge method; experiments with the exploring coil, experiments on the Hall effect, experimental study of currents of telephonic frequency; photographic measurement of condenser discharges; Hertzian waves in air and in other dielectrics; the coherer; electrical resonance; Hertzian waves on wires, and the measurement of electrical indices of refraction.

Frequent reference is made to the following text-books: Ewing's *Magnetic Induction in Iron and Other Metals*, Fleming's *The Alternate Current Transformer*, and Steinmetz's *Alternating Current Phenomena.*

Courses 3 and 4 together are intended to cover the subjects of Magnetism and Electricity, and to give a suitable foundation for students who propose to study Electrical Engineering or the higher branches of Electrical Science.

PHYSICS 6*a*. — Elements of Thermodynamics. Professor HALL.

Course 6*a* is intended for students who have taken Mathematics 2 or its equivalent, and are familiar with the elementary facts and principles of Heat.

Thermodynamics treats of the relations of heat to other forms of energy, and, as such relations are important in a very great variety of physical and chemical operations or states, the province of thermodynamics is extremely wide.

This course undertakes to give familiarity with the two fundamental laws of thermodynamics, and with their application to problems in which heat and mechanical energy are the only forms of energy considered. Some of the special subjects considered are: —

The absolute thermodynamic scale of temperature.
The physical properties of gases and of saturated vapors.
The velocity of sound in a gas, and its relation to the two specific heats of the gas.
The flow of a gas from an orifice.
The theory of the steam injector.
The theory of heat engines.
The theory of refrigerating machines.
The transmission of power by compressed air.

PHYSICS 6*b*. — Modern Developments and Applications of Thermodynamics. Professor HALL.

Course 6*b* is open to students who have taken Course 6*a* or who otherwise satisfy the instructor of their fitness to profit by the course.

This course deals with cases in which chemical and electrical energy, as well as heat and mechanical energy, are involved. Some of the special subjects considered are: —

The "thermodynamic potential" of Gibbs and of Duhem.
The "free energy" of Helmholtz.
The theory of solution.
Osmotic pressure.
The equation of van der Waals connecting the gaseous and the liquid states of matter.
The "phase-rule" of Gibbs.
The "mass law" of chemical equilibrium.
The thermodynamics of a galvanic cell.
Thermoelectricity.

PHYSICS 11. — The Theory of Primary and Secondary Batteries. — Galvanic cells; Lead, Iron-Nickel, and Thallium Storage Batteries; Electricity Direct from Coal. Dr. H. W. MORSE.

Course 11 is open to students who have taken Physics *C* or Physics 1 or the equivalent, and Chemistry 1 or its equivalent.

This course is intended for students who desire an elementary and practical but thoroughly modern treatment of the galvanic cell and storage battery. The following is a tabulated outline of the course : —

The Primary cell : —
  History.
  Outline of modern facts and theories.
  Calculation of electromotive forces.
  Internal resistance.
  Polarisation, depolarisators, etc.
  Efficiency and output.
  Constant and inconstant cells.
  Cells for open and closed circuits.
The Storage cell : —
  Lead, Thallium, Iron-Nickel, etc.
  Mechanical application of the active material to the supporting plate.
  Maximum charge and discharge rates.
  Engineering uses of the storage battery.
  Cells for converting alternating into unidirectional currents.
Electricity direct from coal.
Light-sensitive cells.
Cell types and efficiencies.

CHEMISTRY.

CHEMISTRY 1. — Descriptive Inorganic Chemistry. Professor JACKSON, Mr. ——, and five assistants.

Course 1 may be taken with Physics *B* although in the same examination group.

In this course each student has each week two lectures on Monday and Friday at 12 in Boylston 7, and either four hours of laboratory work or, more commonly, two hours of laboratory work and one of recitation. For laboratory and recitation work there are two divisions (to avoid conflicts), — the first on Tuesday and Thursday from 1.30 to 3.30, the second on Wednesday and Friday from 2.30 to 4.30. The recitations (one hour) come at 1.30 on Thursday for the first division, at 2.30 on Friday for the second, and when they are held no laboratory work is required on these days. Recitations in Boylston 7 ; laboratory exercises in Boylston A or B.

No previous chemical training is required for Chemistry 1, but more advantage will be gained from this course if the student has some knowledge of the general principles of chemistry, such as that given in the chemistry required for entrance to College. The course deals with the preparation, properties, and uses of the more important elements and inorganic compounds. The lectures are illustrated by experiments and diagrams, and in the laboratory those experiments are performed which are not well adapted to the lecture-room. There is no text-book. A pamphlet entitled *Laboratory Experiments in Chemistry 1* is essential; another, *Synopsis of Lectures in Chemistry 1*, is useful, but not essential.

The course trains the memory, the powers of inductive reasoning, the faculties of observation, and of manipulation. It gives a knowledge of inorganic chemistry sufficient for all the ordinary uses of life, even for men engaged in a scientific profession. It carries systematic instruction in inorganic chemistry as far as is desirable; if a man wishes a fuller knowledge of the subject, he can obtain it by study of the larger text-books much more advantageously than by an additional course of lectures.

This is one of the courses required of all students in the Scientific School (except those in Architecture and Landscape Architecture) and for admission to the Medical School. It is also an essential preparation for all the courses which follow.

CHEMISTRY 2. — Organic Chemistry (Elementary Course). Dr. TORREY.

To be admitted to this course the student must have passed Chemistry 1 or *B* (now discontinued), or its equivalent.

In this course a student has three lectures a week during the first half-year. The object is to give a general idea of the chemistry of the compounds of carbon. With Course 1 it presents a general survey of the facts of chemistry. It serves as a preparation for the much more extended course on the same subject (Course 5), and students who can afford the time are strongly advised to use it in this way, but it si not required for Chemistry 5. It differs from the latter in treating the subject with more regard to the practical applications and with less attention to the theoretical consideration of organic compounds. It is intended, also, for students of Biology, and for those who are preparing to enter the Medical School, and the portions of organic chemistry treated will be selected with a special view to the needs of such students.

This course (or Course 5) is required of all those who elect Course 8. Of Courses 2 and 5, only one can be counted for Honors in Chemistry.

CHEMISTRY 3. — Qualitative Analysis. Asst. Professor SANGER and Dr. TORREY, Mr. LANGMAID, and three assistants.

To be admitted to this course the student must have passed Chemistry 1, or have taken a course of descriptive chemistry equivalent to it.

The amount of laboratory work given in this course will occupy an average worker nine hours each week, three of which must come at the hours given in the programme. During the last two years the class was so large that a second division at different hours was arranged for the required three hours of laboratory work, but not for the lectures. The remaining six (or more) hours can come at any time most convenient to the student. At the three required hours the exercises occasionally consist of lectures instead of laboratory work. The text-books are Hill, *Lecture Notes on Qualitative Analysis*; A. A. Noyes, *Qualitative Analysis*; and *Notes on Chemistry 3*, published by the University.

This course trains the student to draw correct inferences in regard to the compositon of substances from a carefully arranged sequence of experiments. It has therefore great educational value, and is also an essential preparation for the more advanced chemical courses. After the analysis of the large number of substances required in this course, the student has a training in qualitative analysis sufficient for all purposes.

It is required for admission to the Harvard Medical School, and students who pass satisfactorily in Chemistry 1 and 3 are admitted without examination in chemistry. It also forms part of the Scientific School courses in Mining and Metallurgy, Biology, and Anatomy and Physiology.

CHEMISTRY 4. — Quantitative Analysis. Dr. BAXTER and Mr. FREVERT.

To enter this course the student must have passed in Chemistry 1 and 3, or courses in the same subjects equivalent to these. Students are allowed, however, to take Chemistry 3 and 4 together in the same year. The work in this course is expected to occupy nine or more hours each week, in the laboratory; three of these hours must come at the times mentioned in the programme, the remaining work can be done at any time most convenient to the student. The regular hours are occasionally occupied by lectures.

The object of this course is to teach the methods of determining the amounts of each constituent in a substance. It gives a general survey of the more important methods, both gravimetric and volumetric. It has less general educational value than many of the other chemical courses, but is the foundation of all advanced chemical work, and therefore essential to those going further in the subject. It also trains the student especially in skill, care, and accuracy, and would therefore be of great value, though not essential, to those who intend to study medicine or certain branches of natural history.

CHEMISTRY 5. — The Carbon Compounds. Dr. TORREY and Mr. RUSSE.

To enter this course the student must have passed Chemistry 1, or an equivalent course in the same subject and must at the same time take

Chemistry *5a*; but, although students who have studied only Chemistry 1 are admitted, it is advisable to have a fuller knowledge of Chemistry (3, 4, and 8) before entering this course. Chemistry 2 is intended to prepare students for this course and is strongly recommended for this purpose, although it is not essential.

In these lectures a systematic course of organic chemistry is given, treating the subject principally from the theoretical side; for, although the applications of the science are described briefly, most of the time is devoted to the description of the preparation and properties of the general groups, and to the elucidation of the structure of the molecules of organic substances, with the methods by which problems relating to organic constitution are solved. A reading knowledge of German is useful, but not required in this course.

This course, in addition to cultivating the faculties trained by the other chemical courses, gives practice in reasoning, and in the correlation of a large number of facts by referring them to general principles. It gives a comprehensive knowledge of organic chemistry, and takes the student as far as is worth while by lectures. Students who wish to pursue the subject further would devote themselves to special lines of study in the chemical journals. It is the essential preparation for research in organic chemistry, and is earnestly recommended to all who intend to make a speciality of chemistry. Candidates for Honors in Chemistry and for the Doctor's degree must pass this course. It is useful but not essential to those who intend to study medicine or biology.

CHEMISTRY *5a*. — The Carbon Compounds. Dr. TORREY and Mr. RUSSE. Laboratory work and conferences.

Chemistry *5a* is open only to those taking Chemistry 5,

This course is devoted wholly to the laboratory methods of organic chemistry. The time is devoted to the methods of organic analysis, and to the preparation of organic compounds. As a general rule, the laboratory work of each man is different from that of his fellows, and may be varied to suit his needs or intentions.

CHEMISTRY 6. — Physical Chemistry. Professor RICHARDS and Mr. FORBES.

The students taking this course are required to have passed in the following courses or their equivalents: Physics 1 or *C*, either Mathematics *A* and *B*, Mathematics *F*, or Engineering 1*b* and 1*d*, Chemistry 4 and 8. It is also very desirable that the students should have a knowledge of Calculus (Mathematics 2 or Engineering 1*c*) and a reading knowledge of German.

Students omitting the laboratory work count Chemistry 6 as a half-course. In this case Chemistry 4 is not necessary as a preparation.

In the lectures a survey of the whole subject is given, including the relations of mass and volume, phase relations, thermochemistry and chemical thermodynamics, chemistry of solutions and the dissociation hypothesis, electrochemistry, and optical chemistry. The laboratory work, which will be arranged to occupy an average man six hours a week, consists of the study of physico-chemical methods as related to the subject-matter of the lectures, and includes among similar subjects the determination of the specific gravity of solids, liquids, vapors, and gases; calorimetry; speed of reactions; boiling and freezing point determinations; and the study of the conductivity of electrolytes.

Text-book: Ostwald, *Physico-Chemical Measurements* (translated by Walker), or Ostwald-Luther, *Physico-Chem. Messungen.* The last German edition is more complete than the translation; this edition is needed in Chemistry 13 also.

Books of Reference: Nernst, *Theoretische Chemie*, 1898; Ostwald, *Grundriss* and *Lehrbuch;* van't Hoff, *Lectures on Physical and Theoretical Chemistry* (translated by Lehfeldt); H. C. Jones, *Outlines of Physical Chemistry;* Le Blanc, *Electrochemistry* (translated by Whitney); Bancroft, *The Phase Rule.*

In addition to the educational value found in the other chemical courses, this gives a certain amount of mathematical practice. It is essential for those who take the research course in physical chemistry, and is recommended to all advanced students in Chemistry. Candidates for Honors in Chemistry and for the Doctor's degree must pass this course.

CHEMISTRY 7. — Electrochemistry. Mr. R. C. WELLS.

This course is open to students who have finished the first half of Chemistry 6, or who have an equivalent preparation in descriptive and theoretical chemistry, the principles of physics, and the elements of physical chemistry. An elementary knowledge of the calculus, although not essential, is urgently recommended.

The lectures will describe the phenomena associated with a passage of electricity through solutions, the production of current and electromotive force by chemical means, and the laws governing these phenomena. From these facts will be developed the hypotheses of dissociation and solution-tension. Some applications of thermodynamics to electrochemistry will be studied. About a third of the time will be given to the study of the uses of electrochemistry in analysis, organic preparations, and technical processes.

Such reading will be required as will acquaint the student with the most recent developments of the subject, but its nature will be adjusted, as far as possible, to individual needs and tastes. This work will be tested by conferences and written reports. The chief books of reference are LeBlanc, *Electrochemie;* Lübke, *Electrochemie;* Haber, *Technische Electrochemie;* Kohlrausch and Holborn, *Leitvermögen der Electrolyte.*

This course is recommended to all who intend to engage in the further study of theoretical and physical chemistry, or in manufacturing chemistry.

CHEMISTRY 8. — The Historical Development of Chemical Theory. Professor RICHARDS and Mr. R. C. WELLS.

This course is required for Honors in Chemistry and for Chemistry 6. It can be taken only by those who have passed in Chemistry 1 and 2, or their equivalent. It consists of lectures upon the history of the science, tracing it from the earliest times to the present day, and dwelling especially on the modern physico-chemical theories. This course should be taken by all who intend to make an extended study of chemistry, for the very elementary knowledge of the theory of chemistry given in Chemistry 1 is inadequate for even a moderately advanced student. Chemistry 8 is essentially non-mathematical, although it demands a knowledge of simple equations. It serves as an introduction to Chemistry 6, where modern theories are discussed in greater detail.

No text-book is required, but the following works are used as books of reference: J. Walker, *Introduction to Physical Chemistry;* Dobbin and Walker, *Chemical Theory for Beginners;* E. von Meyer, *History of Chemistry* (translated by McGowan); Ostwald, *Grundriss* and *Scientific Foundations of Analytical Chemistry* (translated by Walker); Lothar Meyer, *Modern Theories* (translated by Bedson and Williams); Würtz, *Atomic Theory;* Venable, *History of Chemistry*, and *Development of the Periodic Law.*

CHEMISTRY 9. — Advanced Quantitative Analysis. Dr. BAXTER, and an assistant.

To be admitted to this course students must have passed Chemistry 4, or an equivalent course on the same subject. Chemistry 8 also is desirable, but not necessary.

The object of the course is to give the student a fuller and more systematic knowledge of inorganic analysis than is possible in Chemistry 4. At first the various processes and operations are discussed in detail, and subsequently the whole field of the more common elements is surveyed. Emphasis is laid upon the influence of modern theories on the practice of quantitative analysis. The laboratory work, which occupies less time than is required for Chemistry 4, is concerned with typical methods of a complex nature; towards the close of the course it may be varied to suit special needs or desires on the part of the student.

Books of reference: v. Miller and Kiliani's *Analytische Chemie;* Ostwald's *Scientific Foundations of Analytical Chemistry;* Classen's *Ausgewählte Methoden;* Neuman's *Electrolytic Analysis;* Talbot's *Quantitative Analysis;* Sutton's *Volumetric Analysis.*

CHEMISTRY 10. — Gas Analysis. Dr. BAXTER and Mr. GRIFFIN.

This course should follow Chemistry 9, but it may be taken in the same year with Chemistry 4 if the student has obtained the permission of the instructor.

The laboratory work in gas analysis is expected to require at least nine hours a week. It deals with the density of gases, with the volumetric and barometric methods of determining the composition of illuminating and other gases, and with many modern practical applications of gasometric apparatus. Hempel's *Gas Analysis* (trans. Dennis), Travers's *Experimental Study of Gases*, as well as original articles, are used as references.

Chemistry 9 and 10 are intended for those who mean to make a specialty of chemistry, and, while useful for all of these, are essential for those who mean to take the course in inorganic research. Candidates for the Doctors' degrees must pass these courses.

CHEMISTRY 11. — Industrial Chemistry. — Required reading and excursions. Dr. PRINGSHEIM.

This course is open to those only who have passed in Chemistry 1, 2, 3, and who take or have taken Chemistry 4, or their equivalents. Chemistry 5 will be accepted in place of Chemistry 2.

The instruction will be given through lectures and collateral reading, and by occasional visits to manufactories and chemical works.

The lectures will deal with the broad application of chemistry to the useful arts, attention being paid chiefly to the general principles underlying the processes into which chemistry enters. Besides these special processes will be duly considered, and in many cases the methods of industrial analysis will be critically discussed.

The aim of the course is to fit the student for any branch of technical chemistry by making him familiar with the groundwork, leaving the special details to be learned by him after he enters the factory. This treatment of the subject is designed to make the course valuable, as part of a general chemical education, to those men who do not wish to become technical chemists.

CHEMISTRY 12. — Photochemistry, including the Use of Optical Instruments in Chemistry. Dr. BAXTER.

This course is open to those only who have passed or are taking Chemistry 2 or 5, and Chemistry 6.

The theory of the spectroscope, polariscope, and refractometer and the applications of these instruments to chemical purposes, will be considered in the lectures, and the practical use of these instruments will be studied in the laboratory. The effect of light upon chemical equilibrium will be discussed, and under this head the chemistry of photography will receive special attention. The more common photographic processes will be carried out in the laboratory. The laboratory work will constitute at least half of the work of this course.

CHEMISTRY 13. — Experimental Electrochemistry. Mr. R. C. WELLS.

This course is open to those only who take or have taken Chemistry 7. The course can be taken either with Chemistry 7 or in a subsequent year, but the student is recommended to take Chemistry 7 and 13 together.

The work in this course is expected to occupy nine or more hours each week, in the laboratory (Boylston 5); three of these hours must come at the specified times the remaining work can be done at any time most convenient to the student. The regular hours are occasionally occupied by lectures (in Boylston 10). In this course, which supplements Chemistry 7, students will become familiar with the most important laboratory methods in electrochemistry, such as the determination of electrolytic conductivity, of shares of transport, of electromotive force, the use of the coulometer, and the preparation of normal elements and the synthesis of an organic compound. The latter part of the work will consist in more advanced experimental problems adapted to the needs or preferences of the individual. The student is strongly advised to procure as a laboratory guide by ordering in advance: Ostwald-Luther, *Physikochemische Messungen.*

[CHEMISTRY 14. — Advanced Physical Chemistry. — Chemical Kinetics and Equilibrium. Dr. LEWIS.]

Omitted in 1904–05.

This course is open to those only who have passed Chemistry 6 and a course in calculus (either Mathematics 2 or Engineering 1*c*), or their equivalents, and can read scientific German. A fuller knowledge of mathematics and physics than that required above will be advantageous.

The lectures will continue the discussion of the subjects introduced in Chemistry 6. Chemical phenomena will be referred to general laws, and the interdependence of these laws will be shown by the aid of thermodynamics. In discussing the many problems of physical chemistry which have not yet received a final solution, continual reference will be made to current literature. The reading will be chosen to give the student facility in investigation, and the independent solution of physico-chemical problems.

This course is recommended only to those who have a keen interest in the newer problems of chemistry, and who have already begun original research.

RESEARCH COURSES.

The best preparation for research consists in the thorough mastery of all the courses in Chemistry described in the foregoing sections of this pamphlet, but, if the time at the disposal of the student is not sufficient for this, he should consult the teacher of the course in research he wishes to take in regard to the elementary courses to be omitted. The selection of these less essential courses becomes more and more difficult each year with the growth of the interdependence of the different branches of the science; and even in the few cases where an elementary study has no direct relation to a line of research, it is important for the student to master this study in order to increase his breadth of view, and thus make him a better specialist.

Courses 5, 6, 9 and 10 (or their equivalent courses taken elsewhere) are required of all candidates for the Doctor's degree. To obtain the greatest advantage from a research course, the student should devote all his time to it. If this is impossible, he should not undertake one of these courses unless he can give at least half his time to it. No one is allowed to take two research courses in a single year. In every case the professor must be consulted before the course is taken. A reading knowledge of German and French is required for these courses.

Instruction is offered in the following special lines of research:

20*a*. Inorganic Chemistry by Professor RICHARDS.

20*b*. Organic Chemistry by Professor JACKSON.

20*c*. Organic Chemistry by Dr. TORREY.

20*d*. Physical Chemistry by Professor RICHARDS.

20*e*. Applied Chemistry by Professor SANGER.

20*f*. Inorganic Chemistry by Dr. BAXTER.

Arrangements will be made, if possible, to give instruction to students wishing to pursue lines of research not included in these special departments.

In order to give an idea of the nature and scope of the work, a list of the papers of the last five years is given under Chemistry 20*a* and 20*f*, 20*b* and 20*c*, and 20*d* in the Chemistry pamphlet.

CHEMISTRY 20*a* or 20*f*. — Inorganic Chemistry. Professor RICHARDS or Dr. BAXTER.

The number of students in research taken by Professor Richards will be limited. In making the selection, the ability and experience of the candidates will be considered, and usually no student who cannot give all his time to this course will be accepted by Professor Richards. The other students who wish to do original work in inorganic chemistry will be under the direction of Dr. Baxter.

The work in this course has consisted heretofore in (1) The revision of atomic weights; (2) The preparation of new compounds; (3) The separation and study of the salts of the rare elements; (4) Study of the methods of quantitative analysis. Each student selects from these lines of work that for which he is best fitted.

CHEMISTRY 20*b*, or 20*c*. — Organic Chemistry. Professor JACKSON, or Dr. TORREY.

The courses of the two instructors are entirely distinct, and the student must select the course which he proposes to follow.

CHEMISTRY 20*d*. — Physical Chemistry. Professor RICHARDS [and Dr. LEWIS.*]

The work in this course may take any one of the following directions: (1) Electrochemistry; (2) Thermochemistry; (3) Spectroscopy; (4) Photochemistry; (5) Problems in equilibrium. Work in other lines than these could also be arranged, if desired. Each student selects from these the work for which he is best fitted. A knowledge of calculus (Mathematics 2 or Engineering 1*c*) and of Thermodynamics (Physics 6) is essential for most of these lines of work; a more advanced knowledge of mathematics and physics is desirable.

CHEMISTRY 20*e*. — Applied Chemistry. Professor SANGER.

The subjects for research in this course will usually be selected from sanitary or technical chemistry, but will not necessarily be confined to these portions of the science.

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* On leave of absence.

AGRICULTURAL CHEMISTRY.

Agricultural Chemistry. Lectures, Reading, Laboratory. Given at the Bussey Institution. Professor **Storer**.

This course treats of the following: —

Soil, air, and water in their relations to the plant. The food of plants; — manures, general and special. Chemical principles of tillage, irrigation, systems of rotation, and of special crops and farms. The food of animals; simple and mixed rations. Discussion of the values of different kinds of fodders, of the means of determining fodder values, and of the methods of using fodders to the best advantage.

Laboratory instruction in chemical analysis will be given to those students who wish for it.

BOTANY.

Botany 1. — General introductory course. — Botany. Lectures and laboratory practice. Professor **Goodale**, and assistants.

This course is intended for beginners and for those who wish to get a comprehensive view of the subject.

The lectures cover the principal topics in General Botany, the structure, functions, and habits, especially of flowering plants, their classification, distribution, adaptations, and uses. The relations of the subject to evolution are presented, and, as far as possible, illustrated by preparations and living specimens. The plants cultivated at the Botanic Garden of the University are at the service of this elective course, and afford ample material for demonstrations. These resources are supplemented by the specimens in the Botanical Museum. The practical work in this course is conducted in small sections under the direct supervision of trained laboratory assistants, who endeavor to familiarize every student with the principles underlying the general and special morphology of flowering plants, the identification and description of species, and the preservation of botanical specimens.

For laboratory practice, four hours a week are expected. The hours may be selected by the student from the following schedule: —

Sect. 1. *Monday and Wednesday, from 9 to 11.*
Sect. 2. *Monday and Wednesday, from 11 to 1.*
Sect. 3. *Monday and Wednesday, from 1.30 to 3.30.*
Sect. 4. *Tuesday and Thursday, from 11 to 1.*
Sect. 5. *Tuesday and Thursday, from 1.30 to 3.30.*

BOTANY 2. — Morphology of Plants. Professor THAXTER and two assistants.

Botany 2 and Zoölogy 2 form together a laboratory course in "Biology" which affords the necessary elementary training for those who wish to enter more advanced courses in these subjects, or to study medicine; and meets the requirements of those medical schools in which Biology, both botanical and zoölogical, is prescribed for entrance. The two courses cannot be taken separately without the consent of the instructor.

Botany 2 may be taken with advantage in the Freshman year by students who have had some previous training in Botany, or who intend to enter the advanced courses: but in other cases it will be found much more profitable to elect it in the Sophomore or in some later year. The course requires no previous training in Botany; but it is desirable that Botany 1, or its equivalent, should, if possible, precede it.

The course is given on Mondays, Wednesdays, and Fridays during the first half-year. Two to three lectures are given every week, and six hours of laboratory work are required, which should if possible be performed in periods of two or of three *consecutive* hours. The laboratory work, which must be done only on the days mentioned, involves constant use of the compound microscope, in connection with which the simpler manipulations incident to such work are taught, including hand sectioning and the preparation of permanent microscopic mounts, a certain number of which are required to be handed in for inspection, together with the laboratory note-books, at the end of the course. The objects examined in the laboratory are studied and drawn under supervision, and are designed to illustrate the morphology and reproduction of certain more important types throughout the vegetable kingdom. The lectures embrace a comprehensive review of the morphology, development, and reproduction of plants, special attention being given to the lower forms (Bacteria, Fungi and Algae), and to a comparative review of the reproductive processes and their evolution throughout the series.

BOTANY 3*a*. — Morphology, Histology, and Cytology of Flowering Plants. Laboratory practice with lectures and demonstrations. Asst. Professor JEFFREY and an assistant.

This course is a sequel to Botany 1 and Botany 2, or their equivalent. In it special attention is given to the morphology, histology, and cytology of the higher vascular plants. The morphological studies begun in Botany 1 and Botany 2 are continued in such a way that the student becomes familiar with the easier processes of the modern technique of the microscope and at the same time learns the more important features of microscopic structure in the higher plants, which are of morphological and taxonomic importance. The preservation, hardening, embedding, sectioning, staining, and photomicrographing of the tissues and organs of the Phaenogams will be considered in this connection, as well as modern results in regard to evolution and phylogenesis. The subject of cytology will be treated in those aspects which are of importance from the standpoint of the reproduction and the affinities of the Flowering Plants.

BOTANY 3*b*. — Œcology and Physiology of Flowering Plants. — Laboratory practice, with lectures and demonstrations. Asst. Professor JEFFREY and an assistant.

This course can only be taken subsequently to 3*a* or its equivalent. Œcology will be treated from the morphological and physiological standpoints, and in this connection the modifications of outward form and internal microscopic structure, which adapt the higher plants to the more important conditions of life, will receive special consideration. Illustrations of modification in outward form will be supplied chiefly from the collections at the Botanic Garden; but these will be supplemented by dry and wet preparations of plants, which are not thus available, and by photographs. There will be an opportunity to secure a somewhat complete series of slides illustrative of physiological plant anatomy. The physiological exercises and lectures will be carried on in the later spring months in the laboratories and greenhouses at the Botanic Garden, and will be of such a nature as to give a general and prectical view of the more important functions of the Flowering Plants.

[BOTANY 4. — The Bryophyta. — Mosses and Liverworts. Lectures and laboratory work. Professor THAXTER and an assistant.]

Omitted in 1904–05.

This course is given in alternate years with Course 6 and is open only to those who take or have taken Courses 1 and 2 or their equivalent. It gives an opportunity for a more or less detailed laboratory study of some of the more important types of mosses and hepatics, and involves a minimum of six hours of laboratory work, with usually two lectures, a week, which include a comprehensive review of the morphology, development, reproduction, affinities, etc., of the groups.

BOTANY 5. — Outline of Economic Botany. Professor GOODALE and Mr. AMES.

This course, open to those who have taken Courses 1, and 2, or their equivalents, has been estabished with special reference to students who desire to acquaint themselves with useful plants and their products.

Incidentally, the subjects of Botanical Classification, the adaptations of Plants to all of their Surroundings, and Geographical Botany receive due attention.

At the present time, new fields of activity in warm, temperate and in tropical climates are opening to persons who are properly prepared to undertake the care and the improvement of useful plants. To meet the demand for instruction preparatory to this work, Course 5 has been carefully arranged.

The Botanic Garden in Cambridge and the Harvard Botanical Station in Cuba are freely drawn upon for illustrative material. This material, consisting of living plants, is supplemented by the collections of specimens of economic products in the Botanical Museum.

In this course instruction is given in the approved modern methods of collecting and cultivating subtropical and tropical plants, with special regard to the improvement of their yield both in quantity and quality.

BOTANY 6. — The Bacteria, Mycetozoa, and Higher Fungi. — Lectures and laboratory work. Professor THAXTER and an assistant.

This course is given in alternate years with Course 4 and is open only to those who take or have taken Courses 1 and 2, or their equivalents. Opportunity is given for those who desire to learn the ordinary methods of isolating and cultivating Bacteria and Fungi; and representative forms of Bacteria, Mycetozoa, and higher Fungi are studied in the Laboratory. A minimum of six hours' laboratory work is required, and there are two lectures a week. The course is in some respects a continuation of Botany 2, and may be taken with advantage in the same year. It deals with the groups from a somewhat different standpoint, taking them up in greater detail and giving special attention to such matters relating to classification, morphology, reproduction, cytology, etc., as were less fully treated in the elementary course or omitted from it entirely.

BOTANY 7. — Classification of Flowering Plants, with special reference to the Flora of New England and the Maritime Provinces. Lectures and laboratory work. Mr. FERNALD.

The work of this course is intended to give the student familarity with the most characteristic Spermatophytes, a practical understanding of the methods and fundamental principles of Systematic Botany, and an appreciation of the general laws controlling the distribution of plants in the region covered. In the Laboratory the student familiarizes himself with the flora of the region by study of abundant specimens and by the preparation of original keys to the families, genera, and species. During the autumn and spring occasional excursions will be planned to introduce the student to methods of field work.

Course 7 is open to those students only who have taken Course 1 or its equivalent.

[*BOTANY 8. — The Anatomy, Development, and Phylogeny of the Tracheate Zoidogama (Pteridophyta, Cycadofilices, Fossil and Lower Gymnosperms). Asst. Professor JEFFREY and an assistant.]

Omitted in 1904–05.

This course can be taken only subsequently to, or concurrently with, Botany 4 or its equivalent, and is given in alternate years with Botany 9. It is recommended for teachers and for those preparing themselves for research, and involves a minimum of six hours per week of laboratory work.

Special emphasis will be given to the microscopic study of the vegetative and reproductive organs of the lower great groups of Vascular Plants, the Lycopods, the Ferns, and ancestral Gymnosperms, and to their phylogenetic relationships as deduced from an examination of their structure. There will furthur be opportunities to examine into the anatomy and affinities of Ginko, the Cycads, Fossil Gymnosperms, and Cycadofilices. Illustrative material will be supplied from the Botanic Garden, and the large collections of vegetable fossils, and fossil sections in the possession of the Museum.

*BOTANY 9. — The Anatomy, Development, and Phylogeny of the Siphonogama (Higher Gymnosperms and the Angiosperms). Asst. Professor JEFFREY and an assistant.

This course is given in alternate years with Botany 8, and can be taken only subsequently to Botany 8 or its equivalent. Exceptions to this rule can only be made after consultation with the instructor. It is necessary as a preliminary to research, and is also recommended for teachers. Laboratory exercises involve a minimum of six hours per week.

The Coniferae, Gnetaceae, Dicotyledons, and Monocotyledons will be studied from the phylogenetic standpoint. Special facilities will be given for the examination of those features of structure in the reproductive and vegetative organs of the higher Flowering Plants, which are morphologically important. Ontogeny agd anatomy will be emphasized as keys to the taxonomic grouping of the Gymnosperms and Angiosperms.

In connection with this course, some lectures will be given on the structure, properties, and decay of wood. Alternative laboratory exercises devoted to the practical study of the more important American and exotic woods will be effered to students in Forestry who take the course.

BOTANY 11. — Botanical Geography. — Lectures, with prescribed reading, and Seminary. Dr. GREENMAN.

Botany 11 is open only to those who have taken Botany 1, or its equivalent with credit. It is designed especially for those who wish to familiarize themselves with modern views relative to the origin and distribution of plants.

During the first half of the term attention is given to Œcology, or plants in relation to their immediate surroundings, and the latter half of the term to the factors controlling the general distribution of plants, the marking of botanical areas, and finally to plotting, on standard outline maps, the distribution of certain genera and species. The seminary work supplements the lectures and gives ample opportunity for the student to acquaint himself with the important literature on the subject, including the shorter papers constantly appearing in our current scientific periodicals. Standard books relative to the subject are placed in reserve in the College Library. The large collections of the University, particularly the Gray Herbarium, the Botanic Garden, the University Museum, and the different collections of photographs and lantern slides, afford excellent illustrative material.

BOTANY 20*a*. — Experimental Vegetable Physiology. — Economic Botany, with special reference to Tropical Plants. Professor GOODALE and Asst. Professor JEFFREY.

With the advice of the instructors, students select some special topic in one of the branches of botanical research above specified, and carry on their work independently, reporting their results from time to time.

BOTANY 20*b*. — Structure and Development of Cryptogams. Professors FARLOW and THAXTER.

This course is intended for the preparation for and prosecution of original research in the subject. The work requires considerable time, and is adapted to students who have reached a stage of their studies where they can with profit attempt special work, having in view the preparation of an original paper on some subject. The course is further open to properly qualified persons who desire to acquire a special and more or less systematic knowledge of any of the groups of lower cryptogams.

BOTANY 20*c*. — Taxonomy of Phanerogams. Professor B. L. ROBINSON.

Course 20*c* presupposes a knowledge equivalent to that which may be gained from Courses 1, 2, and either 5 or 7. Investigations will be offered in monographic work, plant affinities, the taxonomic aspects of variation and distribution, statistical comparison of floras, etc. The work will be conducted at the Gray Herbarium, which, with its authoritative reference specimens and extensive library, offers exceptional facilities for research in the subjects named. A reading knowledge of French, German, and Latin will be essential to success in this course. It is expected that each student will prepare a thesis for publication.

Summer Courses.

Summer courses which may be counted for A.B. or S.B. are offered.

HORTICULTURE.

HORTICULTURE 1*a*. — Lectures, Reading, Laboratory, Green-house, and Field Work. Given at the Bussey Institution throughout the year. Mr. WATSON.

HORTICULTURE 1*b*. — Lectures, Reading, Laboratory, Green-house, and Field Work. Given at the Bussey Institution throughout the year. Mr. WATSON.

Organic enemies of plants. Diseases due to smuts, rusts, blights, and mildews. Bacterial and constitutional diseases. Structure and habits of insects and methods of combating those kinds which are injurious. Beneficial insects. Influence of insects in pollination. Materials and implements used in spraying to destroy fungi, and repel the attacks of insects. Injuries caused by nematodes, earthworms, birds, mice, and other animals. The lectures are supplemented by laboratory work, which consists of practice in diagnosing diseases and identifying insects in order that the student may become familiar with many of the common enemies of plants.

HORTICULTURE 2. — Study of Plants in relation to Planting Design. — Lectures, Reading, Green-house and Field Work. Given at the Bussey Institution during the second half-year. Mr. WATSON.

HORTICULTURE 3. — Planting Design. — Lectures, Field Work, Drawing. Given at the Bussey Institution during the first half-year and at Cambridge during the second half-year. Professor OLMSTED, and Messrs. WATSON, and SHURTLEFF.

ZOÖLOGY.

ZOÖLOGY 1. — Zoölogy. — Lectures and laboratory exercises. Asst. Professor G. H. PARKER, Mr. L. J. COLE, and other assistants.

This course is designed to acquaint students with the general principles of Zoölogy, and is required as preparation for all other courses in Zoölogy. It includes a brief historical consideration of the science and its subdivisions, and a discussion of the characteristics of animals as represented by their structure and activities. The chief groups of the animal kingdom are outlined and a number of their common representatives described. The distribution of animals in time and space is considered. The study of the structure and functions of cells, tissues, and organs is taken up, as well as the consideration of the forms of animals. The principles governing animal development are dealt with. The relations of animals to their environment and the various theories offered to explain how the modification of animals has been effected are considered.

The laboratory exercises, which do not require dissection by the student, consist of a study of material to illustrate the topics treated in the lectures. These exercises are supplemented by visits to the exhibition rooms of the Museum and, weather permitting, by field excursions.

For collateral reading students are expected to procure R. Hertwig ('02), Thomson ('99), or Parker and Haswell (1900). For more extended reading in connection with parts of the course the following books will be found of service: on systematic zoölogy, Leunis ('83–86); on distributional zoölogy, Beddard ('95), Wallace ('76); on morphology, Parker and Haswell ('97), Lang ('88–94), Wilson (1900), Korschelt und Heider ('90–03); on physiology, Verworn ('01), Schenck and Gürber ('00); on oecology, Semper ('81); on theories of evolution, Darwin ('80), Osborn ('94), Morgan ('03).

ZOÖLOGY 2. — Morphology of Animals. — Lectures and laboratory work. Asst. Professor W. E. CASTLE, and assistants.

This course may be taken separately from Botany 2 only with the consent of the instructor. It is most advantageously taken in the same year as Botany 2 and is open to those only who have taken Zoölogy 1 or its equivalent. Its aim is to afford in connection with Botany 2 the necessary elementary training for those who desire to pursue subsequently the study of some branch of Biology. Since Zoölogy 2 is required as a preparation for several other electives, it should be taken early in the college course; if possible, not later than the Sophomore year. It may be taken in the same year with Zoölogy 1.

The lectures are given on Mondays, Fridays, and occasionally on Wednesdays. They deal with the morphology and biology of the more important groups of animals, and follow immediately the dissection or microscopical examination of a selected representative of each group.

Every student is required to take six hours of laboratory work per week at some time during the eighteen hours of laboratory instruction offered on Monday, Wednesday, and Friday. An excellent guide in the dissection of many of the animals studied is Marshall and Hurst ('99).

The best books for reading in connection with the course are Parker and Haswell ('97) or (1900), and Lang ('88–94). The following works of reference will also be found of value: Delage et Hérouard ('96—) for the classification, anatomy, morphology, and special physiology of invertebrates; Korschelt und Heider ('90–03) for the development of invertebrates; Gaupp ('96—) for the anatomy of the frog; and Leunis ('83–86) for the classification of vertebrates and invertebrates.

ZOÖLOGY 3. — Comparative Anatomy of Vertebrates. — Lectures and laboratory work. Asst. Professor G. H. PARKER and Mr. A. D. HOWARD.

Course 3 is open to those only who have taken Courses 1 and 2.

This course is intended for those who are particularly interested in Zoölogy, and also for those who wish to lay a broad foundation for their subsequent study of human anatomy as medical students.

Lectures are given on Tuesdays and Saturdays. On Saturdays a lecture or laboratory conference may be held. In the lectures special attention is given to evidences of progressive modifications in the structure of the organs as exhibited in passing from lower to higher vertebrates.

Every student is required to take six hours of laboratory work per week at some time during the sixteen hours of laboratory instruction offered on Tuesday, Thursday, and Saturday.

Students are advised to procure Wiedersheim ('02). In addition, the following text-books are recommended: Gegenbaur ('98–'01); Parker and Haswell ('97), vol. 2; O. Hertwig ('96); and Wiedersheim ('02^a). In connection with the laboratory work the following books will be found useful: Parker ('95); Marshall and Hurst ('99).

ZOÖLOGY 4. — Microscopical Anatomy. — Lectures and laboratory work. Professor MARK and Mr. ——.

Course 4 is preparatory to Courses 5 and 20. It is open to those only who have taken Course 2, and take or *have taken* Course 3. It is intended for those who wish to prepare themselves to carry on independent investigations. It presupposes an elementary knowledge of animal morphology, and some familiarity with the use of the microscope. As the number of students who can be accommodated is small, preference will be given to those preparing to take Course 5 or 20.

In this course instruction is given in methods of investigation, the animal studied being some invertebrate. There will be two, or, at the option of the instructor, three lectures a week.

Every student is required to take six hours of laboratory work per week — preferably during morning hours — on two or more of the following days: Monday, Wednesday, and Friday.

Students are advised to buy Lee (1900), and Gage ('01). The following will also be found useful: Behrens, Kossel und Schiefferdecker ('89), Carpenter ('01), Apâthy ('96—), and Haecker ('99).

ZOÖLOGY 5. — Embryology of Vertebrates. — Lectures and laboratory work. Professor MARK and Mr. ——.

Course 5 is open to those only who have taken Course 4.

The lectures in this course deal in a comparative way with the development of vertebrates. The laboratory work consists in the preparation and study of the chick and other vertebrates at successive stages of development. The requirements regarding laboratory work are the same as for Course 4.

Students should procure Foster and Balfour ('98) and O. Hertwig ('02). In addition are recommended O. Hertwig ('01—), Marshall ('93), Minot ('93), Schultze ('97), and Kollmann ('98).

ZOÖLOGY 8. — Fossil Vertebrates. — Lectures and laboratory work. Asst. Professor R. T. JACKSON.

Course 8 is open to those students only who have taken Courses 3 and 9.

This course is intended to acquaint students with the structure of the more important types of fossil vertebrates and their relations to living forms.

ZOÖLOGY 9. — Fossil Invertebrates. — Lectures and laboratory work. Asst. Professor R. T. JACKSON.

Course 9 is open to those only who have taken Zoölogy 1, 2, and Geology 5.

This course is intended to give in zoölogical sequence an acquaintance with the geological history of invertebrates. It considers the structure and development of representative fossil types and their systematic relations to one another and to recent allies. Attention is given to phylogenetic relations as expressed in the development of the individual and in systematic series. The geological occurrence of each group of animals and their relative importance as rock-builders are considered.

Students will find Zittel (1900) a valuable aid in this course.

Zoölogy 9*a*. — Fossil Invertebrates. — Advanced studies of special groups. — Lectures and laboratory work. Asst. Professor R. T. Jackson.

Course 9*a* is open to those only who have taken Course 9.

This course consists of laboratory work with accompanying lectures. It takes up limited groups, such as Actinozoa, Mollusca, Trilobita, etc., and treats of them critically and more in detail than is possible in a general survey of the subject, such as is aimed at in the introductory course, 9. The groups selected will vary according to the needs of students or the pleasure of the instructor.

Zoölogy 10. — Experimental Morphology. — Ontogenesis. — Lectures, laboratory work, and a thesis. Asst. Professor Castle.

Courses 10 and 11 are open to those only who have taken Course 2, and may be taken advantageously either *after* or with Course 3. They are given in alternate years and are not dependent upon each other; accordingly they may be taken in either sequence.

Course 10 is designed for those who are interested in experimental work. The lectures treat of the normal activities and structure of protoplasm and the modifications which they undergo through the action of different chemical and physical agents. Among the topics discussed are response to stimuli, and the influence on the individual of changes in environment brought to bear either on the adult or the embryo.

The laboratory work in Courses 10 and 11 consists of the experimental study of a selected subject on which the student is to report at the end of the course.

These courses require at least such a knowledge of the structure of animals and plants as is gained in Course 2 and Botany 2, and a knowledge of microscopic technique will be found of advantage, although not necessary.

Students will find useful Davenport ('97–99), Verworn ('01), and Morgan ('01).

[Zoölogy 11. — Experimental Morphology. — Phylogenesis. — Lectures, laboratory work, and a thesis. Asst. Professor Castle.]

Omitted in 1904–05.

This course deals with the processes involved in the evolution of races and species. In the lectures, variation and heredity are discussed from the standpoint of statistics and experiment. A presentation is thus made of the scientific principles which underlie successful work in the improvement of races of domesticated animals and plants.

For a statement concerning laboratory work and preparation required for the course, see under Course 10.

Students will find the following books useful: Bateson ('94) and (: 02); Darwin ('76); Galton ('89); Delage ('95); Davenport ('99); de Vries (: 01—03).

[ZOÖLOGY 13. — Comparative Histology, with special reference to Nervous Tissues. — Lectures and laboratory work. Asst. Professor G. H. PARKER.]

Omitted in 1904–05.

This course is intended for those who wish to become acquainted with the structure and genesis of the chief animal tissues, and especially with the structure and functions of the nervous elements in their relations to other tissue elements.

Course 13 is open to those only who have taken Course 2 or its equivalent and who have taken or are taking Course 3.

The laboratory work requires at least six hours a week and must be done on the afternoons of Monday, Wednesday, and Friday.

Students are expected to procure Schneider ('02).

[ZOÖLOGY 15. — The Structure and Functions of the Nervous System and its Relation to Animal Habits. — Sense Organs. — Lectures, laboratory work, and reports. Asst. Professor G. H. PARKER.]

Omitted in 1904–05.

ZOÖLOGY 16. — The Structure and Functions of the Nervous System and its Relation to Animal Habits. — Central Nervous Organs and Terminal Organs of Efferent Nerves. — Lectures, laboratory work, and reports. Asst. Professor G. H. PARKER.

Courses 15 and 16 are designed primarily for those who intend to make a special study of the nervous system and its relation to animal habits.

These courses are given in alternate years. They are open to those only who have taken Course 3. They are independent of each other and may be taken in either sequence. In each course the student will be given a special topic for laboratory work, the results of which are to be presented at the end of the course in the form of a report.

In Course 15 Jourdan ('89) and Lubbock ('88) will be found serviceable.

In Course 16 either Edinger (1900) or Loeb ('99) are required, and Ramon y Cajal ('94), Barker ('99), Van Gehuchten (1900), Donaldson ('95) and Romanes ('93) will be found serviceable.

Zoölogy 20. — Zoölogical Investigations. Professor Mark, Asst. Professors R. T. Jackson, G. H. Parker, and Castle.

This course is designed for those only who are competent, with the aid of the instructor, to carry on some original investigation. Each student selects, with the advice of the instructor, the subject of his research, and the results are embodied in a thesis. The investigations of advanced students, when considered worthy of publication, usually appear in the Contributions from the Zoölogical Laboratory.

Persons contemplating this work will find it to their advantage to consult the Director of the Laboratory at an early date, — if possible, as early as the first of April of the academic year preceding that in which the work is to be done.

The Zoölogical Club.

The instructors and advanced students in Zoölogy hold weekly meetings for the presentation and discussion of original work and the review of current zoölogical literature.

INSTRUCTION BY DOCTORS OF PHILOSOPHY.

By a vote of the President and Fellows, passed January 11, 1897, the Faculty is empowered to authorize any Doctor of Philosophy or of Science who shall be approved by the Department with which his work is most closely related, to give instruction for a period not exceeding four months either gratuitously or for such fees as he may himself fix and collect.

Under this vote the following course has been authorized for 1904–05.

Cytology. (*Second half-year.*) Dr. Alexander Petrunkévitch.

GEOLOGY.

Geology *A*. — Physiography of the Lands (elementary course.) — Lectures, written exercises, laboratory and field work. Mr. P. S. Smith, assisted by Mr. ——.

Geology *A* is required for students who intend to take Geology 6, 7, and 20; it is recommended to students expecting to take Geology 8, in preparation for the more advanced courses in Geology.

Geology *B*. — Meteorology (elementary course). — Lectures, written exercises, observations, and laboratory work. Asst. Professor Ward, assisted by Mr. ——.

Geology *B* is required for admission to Geology 1, 2, 3, 19, and 26.

The lectures present the subject under the following headings: the earth's atmosphere: its composition, temperature, pressure and general circulation. — The moisture of the atmosphere: dew, frost, clouds, rain-fall. — Storms: cyclones, thunderstorms, tornadoes. — Weather. — Climate.

The laboratory work consists chiefly in the construction and study of weather maps; practice in the use of ordinary meteorological instruments; individual record of observations; weather forecasting, etc.

GEOLOGY 1. — Meteorology (second course). — Lectures, observations, and reports. Asst. Professor **WARD.**

Geology 1 is open to those only who have passed Geology *B.*

This course is intended to enable students to make a more thorough study of various important atmospheric phenomena than is possible in the elementary course in Meteorology (Geology *B*). The subjects discussed are as follows: — Dew: theories; measurements. — Frost: conditions of formation; prediction; protection. — Fog: valley, lowland, and city fogs; relation to health; utilization of fog; ocean fog and its relation to navigation. — Haze. — Clouds: methods of formation; classification; methods and results of cloud measurements; photography; clouds as weather prognostics. — Tropical Cyclones: development of the law of storms; directions for handling ships in tropical cyclones; cyclones of West Indies, Eastern Seas, Pacific and Indian Oceans; theory of tropical cyclones.

The laboratory work consists in the examination of charts, photographs, diagrams, etc., and in the study of text-books, reports and articles bearing upon these illustrations. Each student will also make a series of observations on dew, frost and clouds.

GEOLOGY 2. — Climatology of the United States. — Lectures, library work, and reports. Asst. Professor **WARD.**

In Course 2 are considered: The controls of the climates of the United States: — The annual, seasonal and monthly distribution of temperature, pressure, winds, rainfall, cloudiness, and humidity. — The climates of special areas, as, *e.g.*, the Plains; the Pacific Coast; New England; Colorado, etc. — The relations of the climates of the United States to health, habitability, occupations and soil products. — Irrigation: its present status, possible future, and dependence upon the annual rainfall or snowfall.

As a part of the work in this course, each student constructs a series of charts of temperature, rainfall, relative humidity and cloudiness for the United States.

GEOLOGY 4. — Elementary Geology. — Lectures, with collateral reading. Professor **SHALER**, assisted by Mr. P. S. **SMITH.**

GEOLOGY 5. — Elementary Field and Laboratory Geology. Asst. Professor J. B. WOODWORTH, Messrs. —— and ——.

Geology 5, or its equivalent, is required for admission to the higher courses in Geology (8, 9, 10, 11, 12, 14, 16, 17, 18). It is recommended to students taking the courses in Physical Geography.

GEOLOGY 6. — Physiography of the United States. — Lectures, laboratory work, and reports. Professor DAVIS.

[GEOLOGY 7. — Physiography of Europe. — Lectures, library work, and reports. Professor DAVIS.]

Omitted in 1904–05.

Geology 6 and 7 are given in alternate years. They are open to those who have passed in Geology *A* or its equivalent in the admission examinations. Geology 4 also is recommended.

In these courses, the subject will be treated on the plan developed in the elementary course (Geology *A*); the countries considered being divided first according to their geological structure, second according to their geographical development. The physical features of each area will be illustrated chiefly by maps of large scale, partly by photographs. Attention will be given to the relation of structure and form to conditions of human life, occupations, products, etc., in order that the course shall have value to the student of History and Economics, as well as to the student of Geography. The laboratory work consists chiefly of the preparation of maps and diagrams, illustrating selected physiographic features.

GEOLOGY 8. — General Geology. — Lectures, field work, reports, and reading. Asst. Professor J. B. WOODWORTH.

Geology 8 is open to those students only who have attained satisfactory grades in Geology 5, or its equivalent (see Geology S1). Students taking this course must keep Thursday or Friday afternoon free for field work and conference.

The lectures treat of the principles of classification of geological phenomena, the geological processes, their products and criteria; the nature of the forces involved therein; volcanic phenomena; movements of solid masses; the action of water, ice, wind, and life; geological history, including the physical changes, rocks, life, and climate of the principal periods, with reference to evolution, time ratios, continuity of geological processes, etc. Lantern slides are frequently used in illustrating the lectures.

The field work consists of half-day excursions to localities in the neighborhood of Cambridge, illustrating problems in the structure and geological history of the Boston, Norfolk, and Narragansett areas.

The class is divided into sections for library work and consultation.

[GEOLOGY 9. — Structural and Dynamical Geology of the United States. — Lectures, with library work and reports. Asst. Professor JAGGAR.]

Omitted in 1904–05; to be given in 1905–06.

Geology 9 is open to those only who have attained satisfactory grades in Geology 5. Geology *A* and 8 are also recommended.

The aim of this course is to provide opportunity for critical study of the geological structure of the United States in the light of the most recent surveys, with special reference to continental and coastal oscillations, stratigraphy of the larger formations, structure and origin of the mountain ranges, and distribution of eruptive rocks and epochs of volcanic eruption.

In the lectures, the complex structure of the earlier formations is demonstrated as far as possible by analogy with recent phenomena, the area of the United States being used to furnish illustrations of existing processes, and of typical structures resulting from similar processes in the past. Importance is attached to the study of the rock-making agencies of the present time. The lectures are illustrated by stereopticon views, photographs, models, and specimens.

A third hour each week is devoted to reviews, by the students, of recent publications bearing on the subjects discussed in the lectures. The following are among the principal subjects treated: Appalachian stratigraphy; greater unconformities of the Atlantic border; folds and faults of the Appalachians; ancient volcanoes of the eastern United States; Rocky mountain stratigraphy; the great basin; the Coast ranges; the post-Laramie uplift; Tertiary volcanoes of the western United States; structure of the great plains.

GEOLOGY 10. — Mining Geology. — The origin and geological relations of ore-deposits. — Lectures, reading, and occasional field work. Professor SMYTH, assisted by Mr. ——.

Geology 5 and Mineralogy 2, or their equivalents, are required in preparation for this course.

This course is designed to give a general account of the ores of the more important metals. It is divided into two parts. The first deals with ore-deposits in their general mineralogical and geological relations, including their mineralogical and structural characters, the sources from which they have been derived and the processes by which they have been formed. In the second part of the course the more important sources of the world's supply of each metal are studied in some detail. Special attention is given to the ores of iron, copper, nickel, gold, silver, lead, zinc, tin, and manganese.

GEOLOGY 11. — Palaeontology. — Lectures and laboratory work. Asst. Professor R. T. JACKSON, assisted by Mr. ——.

Geology 11 is open to those only who have taken Geology 5 and Zoölogy 1.

This course is intended to serve as an introduction to the study of fossil organisms. It considers the general principles of Palaeontology and takes up in detail representatives of the most important types of fossils, considering the structural and geological relations of each. Geology 11 is introductory to Geology 15 and 24.

GEOLOGY 12. — The Carboniferous Period, with special reference to its physical history. — Lectures, field work, and reports. Professor J. B. WOODWORTH.

Courses 12 and 16 are given in alternate years; Course 12 will be given in 1904–05.

Geology 5 is required for admission to Course 12; Courses *A* and *B*, 8 or 16, and some knowledge of Climatology are recommended as a preparation.

Course 12 deals with the varied physical aspects of a great system of mainly stratified rocks, involving the consideration of a number of general geological problems, many of which are illustrated in Carboniferous rocks of eastern Massachusetts. The course is planned to serve as an introduction to independent research, and Graduate Students will be given opportunity for the study of special topics with the view of ultimate publication of the results. The lectures will be directed more to the discussion of principles and methods of work than to giving information which can be found in the literature of the Carboniferous period or in the field. Students taking this course must keep half a day a week free for field or library work. Properly qualified students who complete this course with credit may on obtaining permission continue the investigation of special topics by enrolling in Course 23 in the second half-year.

GEOLOGY 14. — General Palaeontology. — Lectures, with collateral reading, and theses. Professor SHALER, assisted by Mr. ——.

This course is open to those only who have taken Geology 5, or have an equivalent preparation. Some knowledge of elementary zoölogy, and ability to read scientific French and German are desirable.

This course is intended to give an acquaintance with the geological history of the various organic series, from the point of view of the student of organic life in general rather than in the way required by the practical geologist. Special attention is devoted to the theories concerning the origin and development of animals as far as these questions are brought into view in the palaeontological record. The course varies from year to year, but the following synopsis will indicate the subjects generally treated. Conditions of organic life; heat, moisture, etc.; laws of the distribution of life on land and sea; conditions of fossilization; metamorphism and the preservation of the geological record; climatal and other evidence afforded by fossils. General history of the great divisions of the animal kingdom; the development of the motor system in animals; development of the skeletal, nervous, visual, reproductive, and other systems of the divisions; theories concerning the appearance and disappearance of animals as shown by fossils; palaeontological history of man.

GEOLOGY 15. — Historical Geology. — Laboratory and field work, with conferences and theses. Asst. Professor JACKSON. Occasional lectures in this course are given by Professor SHALER.

This course is open to those only who have some knowledge of Geology and Palaeontology. Geology 8 and 11 afford a suitable preparation.

The course is designed particularly for those who intend making a specialty in Geology; its aim is to teach the use of fossils in identifying geological horizons, especially in the North American series of rocks.

Excursions into the field will be made in the spring recess, and at such other times as are feasible, to give students an opportunity to see fossiliferous geological formations and their succession as far as possible.

[GEOLOGY 16. — Glacial Geology. — Lectures, conferences, field work, and reports. Asst. Professor J. B. WOODWORTH.]

Omitted in 1904–05; to be given in 1905–06.

Geology 16 is open to those only who have passed in Geology 5, or its equivalent. Geology *A*, *B*, 6, and 8 are recommended. Students taking this course must keep one half-day in each week of the autumn free for field-work.

This course treats of the geological work of ice, with particular reference to the Pleistocene Period; the glacial theory; the classification, distribution, age of glacial deposits, their relations to other terrigenous deposits, and to problems of archaeology, engineering, road-making, water-supply, mason's materials, landscape gardening, etc. The field work affords practice in the determination and mapping of glacial deposits.

[GEOLOGY 17. — Experimental and Dynamical Geology. — Lectures, illustrated by experiments, with laboratory work and reports. Asst. Professor JAGGAR, assisted by Mr. ——.]

Omitted in 1904–05.

Geology 17 is open to those only who have attained a satisfactory grade in Geology 5. Geology *A* and Mineralogy 2 are recommended. Ability to read French or German is desirable.

In this course the dynamical and chemical problems of geology are described, and geological processes are illustrated by experiments performed in the presence of the class. Experimental Geology includes analytical observation and measurement of natural phenomena, as well as miniature imitation in the laboratory. As distinct from those courses which treat of form and structure, this course deals with the *physical agents* that produce land forms and geological structures. The work of former experimenters is reviewed, and the laboratory is equipped with apparatus specially designed to reproduce processes simulating erosion, sedimentation, deformation, eruption, and mineral synthesis.

The lectures present the following subjects: *Erosion:* agents of disintegration, hydrographic measurement of streams, action of springs and geysers; experimental erosion and stream development, wear of rocks, turbidity of water, glacial motion and striation. *Sedimentation:* carrying power of wind and water, stratification; experimental delta deposition, unconformity, shore currents, ripple-mark. *Deformation:* measurement of coast oscillation, faults and earthquakes; experimental folds, faults, joints, schistosity, lithifaction. *Eruption:* measurement of active volcanoes; experimental columnar structure, growth of cones, intrusion, imitation of volcanoes, fusing point of lavas. *Crystallization:* hot-spring deposits, solidification of lavas; rock synthesis and its geological significance.

[GEOLOGY 18. — Economic Geology. — Non-metalliferous products and water-supply. — Lectures, reading, and a thesis. Professor H. L. SMYTH.]

Omitted in 1904–05.

Geology 18 is open to those only who have taken Geology 5, or Geology S1, and Mineralogy 2.

This course gives a general account of the occurrence and useful qualities of the principal non-metallic mineral products, special attention being given to those of the United States. The subjects treated are water supply; coal, petroleum, natural gas and other hydro-carbons; phosphates; building stones and materials; road-materials; clays; cement; salts; sulphur, etc.

GEOLOGY 19. — General Climatology. — Lectures, library work, and a thesis. Asst. Professor WARD.

Geology 19 is open to those only who have passed Geology *B*, and to students in the Graduate School having equivalent preparation. It is recommended to those who intend to study medicine.

This course is designed to give a general knowledge of Climatology in its broader aspects. The lectures present the subject according to the following heads: Climatology: its meaning and scope, and its relations to meteorology. — Use and treatment of meteorological observations in Climatology. — The astronomical relations of earth and sun; the changes of the seasons. — Solar Climate. — Climatic factors. — Controls of climate. — The climatic zones and their subdivisions. — Characteristics and hygiene of the zones. — Relations of climate and man, including the climatic control of habitability, occupation, migrations, government, etc. — Physiological effects of different climates. — Acclimatization. — Geological, historical, and periodic changes of climate.

The text-book is the English translation of Vol. I of Hann's *Climatology*.

The library work involves the special investigation by each student of some subject in connection with the course, and the preparation of a thesis.

GEOLOGY 20. — Physiography (advanced course). — Conferences, reports, and theses. Professor DAVIS.

This course is open to those who have passed satisfactorily in Geology *A* and 6 or 7; ability to read German and French and a general understanding of Geology are desirable.

This course is designed to give opportunity for study supplementary to the more elementary courses in Physiography; it will consist of investigation of certain topics selected by the students with the advice of the instructor. Written reports on work accomplished are made by each student. Attendance on the Geological Conference is expected of students taking this course.

GEOLOGY 21. — Mining Geology (advanced course). — Conferences, reports, and theses. Professor H. L. SMYTH.

Geology 10 and Mineralogy 4 are required in preparation for this course.

It is designed to supplement the work of Course 10, by giving advanced students an opportunity to follow out more thoroughly special topics in connection with the geology of ore-deposits.

GEOLOGY 22. — Advanced Geological Field Work. — Areal Geology in the vicinity of Boston. — Library work, conferences, and theses. Asst. Professor JAGGAR, assisted by Mr. ——.

Geology 22 is a course of research, open to those only who have attained a satisfactory grade in Geology 8 or 10, and who have studied mineralogy. Mineralogy 4 and Summer work in Mining 12 are recommended.

This course affords systematic training in methods and practice of geological surveying in the field, and in the preparation of geological maps and reports. During the fall and spring one full day's work each week in the field is required, under the immediate supervision of the instructor. Each student is assigned a definite problem or area, and is required to present his results for discussion at the regular meetings of the course. A few introductory lectures are given, describing the region, the principal rock types, methods of note-taking, use of field instruments and specimen-collecting. During the winter the work consists of map-making, drawing, experimental or library research, or field work upon special problems. Winter lectures treat of the correlation of the region about Boston with adjacent areas in New England, the structural, lithological and palaeontological problems that are here open to investigation, and their bearing upon the field work of the course.

At the close of each field season, a carefully compiled written report, with maps, drawings, and sections, presented in a prescribed form, is accepted as the student's record. These theses are filed, with a view to the eventual publication of a geological map of the Boston area.

Students in Geology 22 are expected to attend the Geological Conferences and to make occasional reports of work in progress.

GEOLOGY 23. — Geological Investigation in the Field and Laboratory, under the supervision of Professors SHALER, DAVIS, WOLFF, and H. L. SMYTH, Asst. Professors J. B. WOODWORTH and JAGGAR.

This course provides more advanced work in the subjects of Geology 22, 10, 11, 12, 16, and 17, and may be taken by students who have passed in any one of those courses. It is intended that the work should lead to results worthy of publication.

The following special topics will, among others, be offered for study during the winter of 1904–05: —

Seashore Phenomena. Auriferous Gravels. Inundated and Arid Lands. Professor SHALER.

Glacial Sand-Plains. Professor DAVIS.

Special Problems in Economic Geology. Professor SMYTH.

The study and mapping of glacial drift, post glacial changes of level, or the stratigraphic and structural geology of southeastern Massachusetts and Rhode Island. Asst. Professor J. B. WOODWORTH.

Experimental Geology, and field studies near Boston, for students who desire to extend the instruction of Courses 9, 22, and 17 into original investigation of structural or dynamical topics. Asst. Professor JAGGAR.

Attendance at the Geological Conference is expected of students taking this course.

GEOLOGY 24. — Advanced Palaeontology. — Laboratory work and theses. Professor SHALER and Asst. Professor JACKSON.

This course is open to those only who have studied palaeontology and zoölogy.

Each student will undertake a careful study of some group of fossil organisms or problem connected therewith. He will be expected to present the result of his studies in a thesis.

[GEOLOGY 27. — Pre-Cambrian Geology of North America: with especial reference to the stratigraphy and economics of the rocks in the original Laurentian area and the region of the Great Lakes. Professor SMYTH.]

Omitted in 1904–05.

Geology 8 and Mineralogy 2 are required in preparation for Geology 27, and Mineralogy 12 is recommended.

The object of this course is to give a systematic account of the present state of knowledge of the pre-Cambrian rocks of the North American continent. The principal subjects dealt with in the lectures are the lithological character of these rocks and their stratigraphical relations, so far as these have been determined, in the various regions in which they have been described; the historical developments of opinion regarding their division into groups; and the time relations of these groups in separated areas.

Especial attention is devoted to the region of the Great Lakes, where, owing to relative simplicity of structure and a generally moderate degree of metamorphism, more definite progress towards a final solution of the problems of classification has been made than in any other area. During the course, the subjects of metamorphism, the development of secondary rock structures, and the principles of correlation applicable to non-fossiliferous formations, are considered in detail.

SUMMER COURSES IN GEOLOGY AND GEOGRAPHY.

A full account of the Summer Courses is published in a special pamphlet which may be had on application to the Secretary of the Lawrence Scientific School.

MINERALOGY AND PETROGRAPHY.

MINERALOGY 2. — Mineralogy (including Crystallography, Physical and Chemical Mineralogy, and Descriptive Mineralogy). Asst. Professor PALACHE, assisted by Mr. ——.

Open to those only who take or have taken Chemistry 1. Students proposing to study Petrography are advised to take Course 8 with Course 2.

Text-book: Dana's *Text-book of Mineralogy.*

The lectures first take up Crystallography, while the laboratory work is upon the collection of crystal models and natural crystals. An outline of Physical and Optical Mineralogy is briefly presented by lectures and demonstrations with the polariscope. The larger part of the lectures and laboratory work is, however, devoted to systematic Descriptive and Determinative Mineralogy, which includes the chemical relations of the various species. The lectures are illustrated by specimens from the several collections, while in the laboratory students are taught the various blow-pipe and other chemical tests, which they apply themselves on known and undetermined material. They follow the lectures with the minerals in the collection, and are then given drawers of unknown minerals to determine.

A student who has passed this course should have a knowledge of Mineralogy sufficient for all general purposes; he should be able to identify all but the rarer mineral species. If he wishes to pursue the subject further, he should take up special lines of study. The course is essential for all who wish to go on in Mineralogy or Geology, and is recommended to all those who intend to be chemists. It affords training in observation and inductive reasoning for all engaged in the natural sciences. On this account it is also fitted to form part of a general education.

MINERALOGY 4. — Elementary Petrography. — Lectures and laboratory work. Professor WOLFF, assisted by Mr. ——.

Course 4 is open to those only who have taken Geology 4 and 5 (or S1) and Mineralogy 2.

The lectures treat of the structure, composition, origin, geographical distribution and geological occurrence of the various families of rocks, and include the microscopical characters of the commoner rock-forming minerals. The laboratory work supplements the lectures and enables students to become familiar with rocks and the ordinary methods of investigation.

MINERALOGY 7. — Advanced Crystallography and Mineralogy. — Lectures, laboratory work, and a report. Asst. Professor PALACHE.

Course 7 is open only to those who have had Course 2 or its equivalent. The course is intended to enable students to make a more thorough study of a number of topics not considered, or treated incompletely in the elementary course. The subjects treated in the lectures will be in part as follows: Crystallography; classification of crystals by symmetry; theories of crystal structure; zonal crystallography; use of the reflecting goniometer for crystal measurement; methods of calculation and projection of crystals; Physical Crystallography; cohesion, gliding planes and etch figures; electrical properties; thermal properties, etc.; Chemical Mineralogy: isomorphism, morphotrophy, minerals as solid solutions, etc.; Descriptive Mineralogy: description of less common minerals; minerals of the rare earths; the radio-active minerals, etc.

The laboratory work will consist chiefly in the measurement of crystals and in discussion of the results and drawing of the forms. There will also be some work in the production and interpretation of etch figures.

MINERALOGY 8. — Optical Crystallography. — Lectures and laboratory work. Professor WOLFF.

This course is open to those only who take or have taken Mineralogy 2. Course 7 is especially useful to chemists, and Course 8 to petrographers; while both courses are essential to those who wish to go further in Mineralogy.

The lectures deal mainly with crystal optics. The later lectures will be devoted to the applications of Optical Mineralogy in the study of minerals in Mineralogy and Petrography. The lectures will be illustrated by the polariscope and other demonstrations. The laboratory work will consist in the determination of the indices of refraction and other optical constants of minerals of the several systems, partly by means of preparations which the students will make themselves. The laboratory work of Courses 7 and 8 is carried on in the advanced mineralogical laboratory.

MINERALOGY 9. — Advanced Crystallography (second course). — Laboratory work in the measurement of crystals and the study of their physical characters; reading and a thesis. Asst. Professor PALACHE.

Course 9 is intended primarily for those who wish to continue the work of Courses 7 and 8. It is open to those only who have taken Courses 2 and 7. Course 8 is recommended.

MINERALOGY 12. — Advanced Petrography. — Lectures, laboratory work, and reading, with a thesis. Professor WOLFF, assisted by Mr. ——.

Course 12 is open to those only who have taken Course 4. Mineralogy 8 is recommended.

The work of this course gives partly by lectures, combined with laboratory work and reading, a more advanced and detailed treatment of the subject than Conrse 4. It will include practice in the special laboratory methods for the study of rocks, the classification of rocks and the problems of lithological geology. In the latter part of the course each student will make a detailed study of a group of rocks and embody the results in a thesis.

MINERALOGY 20. — Research in Mineralogy, Crystallography, or Petrography. Professor WOLFF and Asst. Professor PALACHE.

Every facility will be given to students fitted for research in Mineralogy who wish to pursue the subject. A collection of minerals for scientific use is now in process of formation and will be extended in special lines as the need arises. Students taking this work should have passed in Mineralogy 2, 7, 8, and 12, Chemistry 1, 3, 4, 9, and Geology 4 and 5. This course should be taken only if the student is able to devote at least half of his time to it; to get the full advantage of it he should devote all his time to it. The work will consist in establishing new mineral species or the revision of old ones; in the study of the relation of the physical properties to chemical composition, or in the critical examination of some of the fuller suites of species contained in the collections.

Corresponding facilities for petrographical research are offered to students with a knowledge of general petrography such as is obtained from Courses 4 and 12, in connection with the extensive laboratory and library resources of the Department and the varied field-problems of the region. The work is preferably based on material which the student has collected in the field in connection with the determination of field relations, utilizing the winter months for lithological study.

MINING AND METALLURGY.

Mining 1. — Elements of Mining. — Prospecting, Exploring, Development and the principles of Exploitation. — Stamp-milling and ore concentration. Lectures, reading, and excursions. Laboratory (or field) work one afternoon every other week. Professor H. L. Smyth and Asst. Professor Raymer, assisted by Mr. Bell.

This course must be preceded by, or taken in the same year with, Geology 10 and Mineralogy 2.

Course 1 may be counted towards the degree of A.B.

This course deals first with the practical methods of geology, which have for their object the discovery of mineral deposits, and the approximate determination of their extent and value. Attention is given to magnetic surveys with the dial-compass, dip-needle, and magnetometer, and their application to certain fields in the Eastern States and the Lake Superior region. Other subjects treated are diamond- and churn-drilling and test-pitting; the principles and methods of sampling; faulting in mineral deposits; and the principal methods of opening up and working bodies of ore.

Towards the end of the course eight or ten lectures are devoted to the preparation of ores for smelting by wet methods of concentration, and to the treatment of gold-ores by stamp-milling, chlorination, and cyaniding.

The laboratory work consists in simple exercises with the gold-pan and batea, including the pan-assay of gold ores; also sampling, and indoor work with the magnetometer.

Field work in May includes practice in the use of the magnetic instruments, and in the sampling of a vein.

Metallurgy 2. — Metallurgy of Iron and Steel. — Lectures, reading, laboratory work, and excursions. Asst. Professor Sauveur and Mr. Boynton.

Course 9 is required in preparation for this course. Course 2 cannot be counted towards the degree of A.B.

Students of Civil and Mechanical Engineering who are required to take this course are admitted to it without having had Course 9, and are excused from laboratory work.

This course will include a description of the methods used for the production of cast iron, wrought iron and steel. The mechanical appliances will be described briefly and properly illustrated, while special effort is made to convey a clear understanding of the chemical and physical phenomena upon which the art of the production of iron and steel is based.

The further treatment to which the metals are subjected in the production of the most important finished articles is considered.

The properties of cast iron, wrought iron, and steel which have an industrial interest will be carefully studied, as well as the influence upon these properties of the composition and the treatment.

The complex question of the rational treatment of steel in the manufacture of finished products will receive special attention.

The constitution of iron and steel as revealed by the microscope will be studied.

The laboratory work will include annealing, hardening, and tempering of various grades of steel and the study of the changes of properties brought about by these treatments as ascertained by physical tests; the determination of the thermal critical points of iron and steel; the case hardening of steel; the malleablizing of cast iron, etc.

METALLURGY 3. — Metallurgy of Copper, Lead, Zinc, and the Minor Metals, and of the Precious Metals in connection with Copper and Lead. — Lectures and reading. Laboratory work one afternoon a week. Professor PETERS, assisted by Mr. BELL.

Course 9 is required in preparation for this course. Course 3 cannot be counted towards the degree of A.B.

Under copper will be included the principles underlying the various processes, a detailed account of the methods employed in the extraction of copper from its ores, and of the precious metals in connection with copper; the refining of products and the electrolytic refining of copper; also the wet methods for the extraction of copper. Under lead will be included a discussion of the principles underlying the various processes, the processes themselves, and the desilverization and refining of products.

MINING 4. — Ore Dressing, Concentration, and Milling. — Wet methods of ore-treatment. — Lectures and laboratory work. Asst. Professor RAYMER, assisted by Mr. R. N. WOODWORTH.

Engineering 1*c* and Mining 10, or their equivalents, are required in preparation for this course.

The lectures will describe the principles of the dressing and concentration of lead, zinc, and iron ores; of the stamp milling, amalgamation and leaching of gold and silver ores, and the designing and erection of plants for such work.

The laboratory work will enable the student to become familiar with the use of the modern machines for ore dressing, concentration and amalgamation, including crushers, rolls, stamps, screens, jigs, vanners, slime tables, and buddles; and with their adaptability to given ores.

MINING 5. — Metal and Coal Mining. — Exploitation. — Lectures, reading, and reports. Professor H. L. SMYTH.

Engineering *5a* and Mining 1 are required in preparation for this course.

This course is designed to give a systematic account of the operations incident to the development and working of coal-seams, and ore-bodies of various forms, sizes, attitudes and physical characters under different conditions. The subjects treated are surface-excavation, hydraulic and open-pit mining, tunnelling, shaft-sinking, hand- and power-drilling, explosives, systems of mining, tramming and underground-haulage, hoisting, surface-handling, drainage, and ventilation.

The instruction is given by lectures supplemented by required reading in various text-books and in professional literature. The lectures are illustrated with maps and photographs. The student is required to solve a considerable number of problems in connection with the lectures and to work up three projects.

METALLURGY 6. — Metallurgical Chemistry. — The analysis of ores and metals (chiefly laboratory work). Mr. C. H. WHITE, assisted by Mr. BOYLSTON.

Chemistry 3 is required in preparation for this course.

This course deals with the quantitative determination of the essential metallic elements and the important impurities in the ores of iron, aluminum, manganese, lead, copper, and zinc. Many determinations of each element are made by the more important standard and technical methods in practical use; attention being given to rapidity as well as accuracy.

The work in this course requires of the average student about twelve hours a week. Three of these hours are at the times stated in the "Elective pamphlet;" the others, when most convenient to the student.

METALLURGY 7. — Metallurgical Chemistry (advanced course). — The analysis of metallurgical materials and products (chiefly laboratory work). Mr. C. H. WHITE.

Metallurgy 6 or Chemistry 4 is required in preparation for this course.

The laboratory work in this course consists of practice in the analytical methods used in metallurgical establishments. The processes adapted to steel-works laboratories receive special attention; but the laboratory work may be varied, within certain limits, according to the needs of each student. The time required for the laboratory work is about nine hours a week.

The lectures come once a week and include the consideration of the theory of the methods and of their applicability to the needs of the metallurgical analyst.

The subjects considered are: the complete analysis of ores, metallurgical products, fuels, fluxes, furnace and flue gases, and refractory materials.

METALLURGY 8. — Leaching Processes for Gold and Silver Ores. — Lectures, laboratory work, and reading. Mr. C. H. WHITE.

Metallurgy 6 and Mining 10 are required in preparation for this course. It cannot be counted towards the degree of A.B.

In this course the practical methods for the extraction of gold and silver from their ores by means of solvents are studied in detail. The consideration of each process, including the operations of solution, filtration, precipitation, and recovery of the metals, involves a study of the chemistry of the method, the preparation and testing of solutions, the plant, the character of the ores to which the process is adapted, and the preparation of the ore for treatment.

The laboratory work affords practice in the treatment of several ores by the various methods, in determining the efficiency of the processes under varying conditions, and in making such chemical tests and analyses as are required for their successful application.

METALLURGY 9. — General Metallurgy. Lectures and Reading. Asst. Professor SAUVEUR and Mr. BOYNTON.

Chemistry 1 is required in preparation for this course.

The aim of this course is to impart to the student a general knowledge of metallurgy, of the materials used in metallurgical operations and of the resulting products, as well of the chemical and physical principles upon which the art of metallurgy is based. It constitutes an introduction to Metallurgy 2 and 3, and will prepare the student for these courses so that he will be able to follow them more intelligently and with greater profit.

The course will include a description of the materials (fuels, refractory materials, etc.), and of the appliances (furnaces, crucibles, etc.) used in metallurgical operations; and of the products resulting from these operations (metallic products, slags, and gases).

The metallurgical processes will be classified and the most important will be briefly described.

The constitution and physical properties of industrial metals and alloys will be considered, as well as the influence of impurities and of treatment upon these properties.

The laboratory work consists of simple experiments dealing with the products of refractory materials, slags, the calorific power of fuels, pyrometry, etc.

MINING 10. — Fire-Assaying (chiefly laboratory work). Asst. Professor RAYMER, assisted by Mr. R. N. WOODWORTH.

Mineralogy 2 is required in preparation for this course.

The work of this course is mainly in the laboratory, and requires of the student eight to ten hours a week.

The following subjects are treated: The scorification assay of gold and silver ores, including cupelling, inquarting, parting, and weighing; the crucible assay of gold and silver ores, including the determination of fluxes; the corrected assay of rich ores and precipitated sulphides; the amalgamation assay of free-milling ores; the combination assay of mattes, speisses, etc.; the assay of lead-ores and lead bullion; the assay of gold bullion.

MINING 11. — Mining Plant. — Hoists, pumps, drills, compressors, and haulage-equipment. — Lectures, reading, and reports. Asst. Professor RAYMER.

Mining 5 is required in preparation for this course.

The lectures will describe the designing and erection of power plants for mines; methods of transportation, underground and on the surface; ventilation, natural and forced; hoisting and pumping; the generation of steam and its use in mining; the compression of air and its use in mining; the use of electricity in mining.

MINING 12. — Mining. — The Study of Mining Operations. — Field work and a report.

Mining 1 is required as a preparation for this course. It is open only to students of Mining and Metallurgy in the Lawrence Scientific School.

In 1904, this course will be given in the George Crocker School of Practical Mining in Colorado.

This course begins in some mining region shortly after the end of the final examination period. The student under the guidance of the instructor spends eight to ten hours a day in the study of the actual working of mines, on the surface and underground. Attention is specially directed to the plant and its arrangement, and to the various departments of underground work. After the detailed study of one or more mines has been completed, other mines and districts are visited and variations in practice compared. The student is required to take full notes each day, and to hand in a written report, with his note-book, at the end of the summer vacation.

In the summer of 1899 the class worked in the iron mines of Minnesota, and in the copper mines of Keweenaw Point, Michigan. In 1900 it visited the anthracite region of Pennsylvania, and the iron mines of the Adirondacks. In 1901 the fields selected for study were the Marquette and Menominee ranges, and the copper mines of the upper peninsula of Michigan. In 1902 the work was done in Colorado and Utah.

METALLURGY 14. — Metallography. — Lectures, laboratory work and reading. Asst. Professor SAUVEUR, assisted by Mr. BOYNTON.

Metallurgy 2 is required in preparation for this course.

The lectures of this course include a description of the operations required to make the structure of metals apparent under the microscope, and of the examination and photographing of the revealed structure. The microstructure of industrial metals and alloy will be fully described and illustrated, and the influence of chemical composition and treatment (both thermal and mechanical) upon the structure carefully considered, as well as the close relation existing between the structure and the physical properties.

The modern theory of metallic alloys, based in part upon their microstructure, will receive proper attention.

A practical knowledge of the technology of the subject will be imparted to the student by a series of laboratory experiments. Samples of the most important industrial metals and alloys will be polished, etched and otherwise prepared for microscopical examination and the resulting structures photographed. The influence of chemical composition and treatment upon the structure and the relation between the structure and the physical properties will be ascertained by properly selected experiments, which will include the use of the Le Chatelier thermo-electric pyrometer, the determination of the thermal critical points of iron and steel, etc.

The student should acquire in this course a good working knowledge of metallographic methods and manipulations.

METALLURGY 15. — Metallurgy of Zinc, Nickel, Tin, Mercury, and the Minor Metals. — Lectures and reading. Professor PETERS.

Course 3 is required in preparation for this course. It cannot be counted towards the degree of A.B.

This course supplements Course 3, and, taken with it, covers the metallurgy of all the commercially important metals except iron.

MINING 17. — Mine Surveying. — The general principles of underground and claim surveying. — The construction of maps, sections, and models. — Lectures and reports. Asst. Professor RAYMER.

Engineering 4*a*, 4*c*, and 4*d* are required in preparation for this course. It is open only to students of Mining and Metallurgy in the Lawrence Scientific School.

The course deals with the application of the principles of surveying to mines and mining claims, and includes the use of the compass, level and transit in such work; the laying out of mining claims; surveys for patent; calculation of conflicts, and the general work required of United States Mineral Surveyors; the surveying and levelling of ditches for placer workings; the construction of mine maps, sections, and models.

The lectures will embrace a consideration of Mining Rights in Lode and Placer Claims, possessory or patented, and of Land Office Rules on these subjects. During the latter part of the course some time will be devoted to field work and mapping.

METALLURGY 20. — Metallurgy and the Physics of Metals. Asst. Professor SAUVEUR.

A few lines of investigation, that may be followed by properly qualified students, are suggested below:

I. Relations between the structure of a certain metal or alloy and its physical properties.

II. Influence of the treatment (thermal and mechanical) upon the structure and properties of a certain metal or alloy.

III. Influence of impurities upon the structure and properties of a certain metal or alloy.

IV. Influence of varying proportions of the constituents of a metallic alloy upon its structure and properties.

V. Influence of the composition and treatment upon the position of the critical points of steel.

VI. Determination of the critical points of special steels which have not so far been determined.

VII. Preparation of a new special steel and investigation of its properties.

VIII. Preparation of a new metallic alloy and investigation of its properties.

IX. Investigation concerning the effect of composition and treatment upon the magnetic properties of steel.

X. Determination of the curve of fusibility of alloys of unknown constitution.

MINING 22. — Problems in the Treatment of Ores. — Laboratory work and a thesis. Asst. Professor **RAYMER** and Mr. C. H. **WHITE**.

In this course the student is given an ore of unknown composition. His problem is to determine the method of treatment by which the value of the ore may best be recovered.

He begins by sampling and analyzing or assaying it and subjecting it if necessary to preliminary laboratory tests, such as concentration, pan-amalgamation, screen tests, lixiviation, etc., from the results of which he deduces a suitable process. He then subjects the ore in considerable quantity to this treatment, the recovery and sources of loss at every stage being carefully investigated.

Finally, he systematizes and discusses his data in a report, which is accompanied by designs for a plant for a treatment of the ore on a commercial scale by the method selected.

MINING 24. — Mine Examination and Reports. Professor H. L. **SMYTH**.

In this course, which may be taken only by candidates for the degree of Mining Engineer, the examination, sampling, and determination of the commercial value of mineral deposits, and the preparation of reports, are treated in the lectures.

Towards the close cf the year, the students make an investigation of a mineral deposit, and survey and sample it. From the data gathered on the ground maps and assay plans are prepared, and a full report is presented.

METALLURGY 26. — Advanced Course in the Mətallurgy of Copper, Lead, and the Minor Metals. Professor **PETERS**.

This is an advanced course, intended for students who expect to practice metallurgy. Some of the principal topics with which it deals are: The history and development of metallurgical processes; a study of slags, with particular reference to their suitability to the different smelting processes; the compounding of furnace charges and calculation of slags as practiced at smelters; the effect of fumes upon animal and vegetable life, and the means for mitigating their effect; thermal calculations; the construction of smelting plants.

MINING 28. — Geological Surveying. — Field work, conferences, and theses. Asst. Professor **JAGGAR**, assisted by Mr. **MANSFIELD**.

This course is prescribed for fourth-year students in Mining, and may not be taken by others.

This course, which is conducted as a course of research, affords training in methods of geological surveying in the field, and in the preparation of geological maps and reports. During the autumn one full day's work each week in the field is required, under the immediate supervision of the instructor. Each student is assigned a definite problem or area, and is required to present his results for discussion at the regular meetings of the course. A few introductory lectures are given, describing the region, the principal rock types, methods of note-taking, use of field instruments and specimen-collecting. During the winter the work consists of map-making, experimental or library research, or field work upon special problems. Winter lectures treat of the correlation of the region about Boston with adjacent areas in New England, the structural, lithological, and palaeontological problems that are here open to investigation, and their bearing upon the field work of the course.

At the close of the field season, a report with maps, drawings, and sections, presented in prescribed form, is accepted as the student's record. These theses are filed with a view to the eventual publication of a geological map of the Boston area.

GEOLOGICAL CONFERENCE.

The instructors of the above-described courses meet their more advanced students in the Geological Laboratory at 8 on Tuesday evenings, for the presentation of reports on investigations, and for informal comment and discussion. At each meeting there will be one or more leading papers on subjects announced in the weekly Calendar, and discussion will be directed chiefly to the subjects thus presented. There will be also brief statements of work in progress by instructors and students, and comments on new publications and other matters of interest.

ANTHROPOLOGY.

ANTHROPOLOGY 1. — General Anthropology. — Lectures and theses.
Dr. FARABEE.

This introductory course is designed for students wishing to obtain a general knowledge of the whole field of Anthropology. An outline is given of the physical characters of man and his division into races and varieties. Man's origin and distribution from geological to historical time is considered. A study is made of the languages, customs, arts, institutions, and beliefs of the various peoples.

Voluntary field work, under guidance, is offered in vacations in connection with this course.

HYGIENE.

HYGIENE 1.—Elementary Anatomy and Physiology.—Personal Hygiene.—Emergencies. Drs. DARLING, PROVANDIE, BACON, and HAPGOOD.

This is an introductory course intended to give the general knowledge of Human Anatomy, Physiology and Hygiene which should be possessed by every student; it is adapted not only for those who intend to study Medicine or Physical Training, but also for those who wish to obtain general information on the subject.

HYGIENE 4.—Anthropometry.—Measurements and Tests of the Body.—Effects of Age, Nurture, and Physical Training.—Lectures and Practical Exercises. Dr. D. A. SARGENT.

Courses 4 and 5 must be preceded by Course 1 or its equivalent.

Systematic training is given in making measurements and tests of individuals for the purpose of determining their strength and deficiencies. Practice is also given in classifying measurements, forming typical groups and determining the relations of the individual to the group type.

HYGIENE 5.—Applied Anatomy and Animal Mechanics.—Action of the Muscles in different Exercises.—Lectures and Demonstrations. Dr. D. A. SARGENT.

A study is made of the effects of various exercises upon the human organism, the physical characteristics of distinguished athletes, and the mechanical principles underlying the ability to perform great feats of strength, skill, endurance, etc.

This course must be preceded by the course in Hygiene 1, or its equivalent.

SUMMER COURSES OF INSTRUCTION.

Among the courses of instruction to be offered by Harvard University in the summer of 1905, there will be several that can be counted, under the regulations of the Faculty of Arts and Sciences, towards the degree of S.B.

For the pamphlet describing the Summer School Courses apply to J. L. LOVE, 16 University Hall, Cambridge, Mass.

PUBLICATIONS.

Some Departments of study issue periodicals or yearly volumes, embodying the work of instructors and students at the University. Other Departments make regular contributions, under an official heading, to the proceedings of certain learned societies or to journals of literature and science, existing outside of the University. The publications of the first class and those of the second which are also issued directly by the Departments are the following; including a few which, although connected with studies cultivated by the Faculty of Arts and Sciences, are independent of that Faculty: —

HARVARD ORIENTAL SERIES (Indic Philology Department): Vols. I–IV issued. Vols. V–X in press.

HARVARD STUDIES IN CLASSICAL PHILOLOGY (yearly): Vols. I–XIV issued. Vol. XV in preparation.

STUDIES AND NOTES IN PHILOLOGY AND LITERATURE (Modern Language Departments): yearly. Vols. I–VIII issued.

HARVARD HISTORICAL STUDIES: published under the direction of the Department of History and Government, from the income of the Henry Warren Torrey Fund. Vols. I–IX issued.

QUARTERLY JOURNAL OF ECONOMICS: in its eighteenth year.

ANNALS OF THE OBSERVATORY OF HARVARD COLLEGE: fifty volumes issued.

ANNALS OF MATHEMATICS, NEW SERIES, issued quarterly under the management of the Division of Mathematics: in its fifth year.

CONTRIBUTIONS FROM THE CRYPTOGAMIC LABORATORY: fifty-five numbers issued.

PUBLICATIONS OF THE MUSEUM OF COMPARATIVE ZOÖLOGY: — BULLETIN, thirty-nine volumes issued; MEMOIRS, twenty-five volumes issued.

CONTRIBUTIONS FROM THE ZOÖLOGICAL LABORATORY: one hundred and forty-seven numbers issued. (Some of the contributions are also contained in the Museum Bulletin.)

PUBLICATIONS OF THE PEABODY MUSEUM OF AMERICAN ARCHAEOLOGY AND ETHNOLOGY: — ANNUAL REPORTS, thirty-six numbers issued; PAPERS, seven numbers issued; MEMOIRS, eight numbers issued.

The HARVARD GRADUATES' MAGAZINE, issued quarterly, and now in its twelfth year, gives a record of the current life and work of the University, biographical and bibliographical data regarding Graduates, besides articles on other matters of general interest.

CLUBS.

Important work is done by students in Clubs which exist in more or less close connection with the several Departments of study, and meet frequently. These organizations, concerning which detailed information is given in the Departmental Pamphlets or may be obtained from instructors, include the following: —

Sanskrit Conference: fortnightly in the second half-year.
Classical Club: fortnightly.
Modern Language Conference: fortnightly.
Deutscher Verein: fortnightly.
Cercle Francais: fortnightly.
Philosophical Conference: monthly.
Harvard Pedagogical Club: fortnightly.
Harvard Memorial Society.
Harvard Folk-Lore Society.
Harvard Musical Club: fortnightly.
Harvard Physical Club: twice in three weeks.
Harvard Chemical Club: fortnightly.
Boylston Chemical Society: fortnightly.
Botanical Conference: fortnightly.
Botanical Club: fortnightly.
Zoölogical Club: weekly.
Harvard Natural History Society: bi-monthly.
Harvard Engineering Society: monthly.
Harvard Mining Club: fortnightly.

To these are to be added the Semitic Conference, the Mathematical Conference, the Physical Colloquium, and the Geological Conference (see Announcement), which have something of the character of clubs.

Besides the above named clubs, existing for purposes of special study and discussion, there are organized in the University many societies having religious, ethical, political, literary, musical, and social objects. The Graduates' Club, maintained by students in the Graduate School, may be especially mentioned. Its circular may be obtained on application.

For a record of portions of the work of the seminaries, conferences, and clubs, during the year 1902–03, see pages 468–473, University Catalogue, for 1903–04.

THE UNIVERSITY CHAPEL.

BOARD OF PREACHERS.

Francis Greenwood Peabody, D.D.,	*Plummer Professor of Christian Morals.*
Lyman Abbott, D.D., LL.D.	*Preachers to the University for the year* 1903–04.
Francis Brown, D.D., LL.D.	
Floyd Williams Tomkins, D.D.	
Henry Van Dyke, D.D., LL.D.	
William Wallace Fenn, S.T.B.	

There have also served on this Board since its foundation in 1886: —

Edward Everett Hale, D.D.
Alexander McKenzie, D.D.
Theodore C. Williams, S.T.B.
George A. Gordon, D.D.
Phillips Brooks, D.D.
William Lawrence, D.D.
Brooke Herford, D.D.
Henry Van Dyke, D.D.
Lyman Abbott, D.D.
Charles Carroll Everett, D.D.
Washington Gladden, D.D.
Leighton Parks, D.D.
J. Estlin Carpenter, A.M.
E. Winchester Donald, D.D.
Samuel McChord Crothers, D.D.
Simon J. McPherson, D.D.
John H. Vincent, D.D.
Samuel D. McConnell, D.D.
Philip S. Moxom, D.D.
William Wallace Fenn, S.T.B.
George Harris, D.D.
George Hodges, D.D.
William DeWitt Hyde, D.D.
William H. P. Faunce, D.D.
William J. Tucker, D.D.
Charles Cuthbert Hall, D.D.
Robert MacDonald, S.T.B.
Endicott Peabody, LL.M., S.T.B.
Paul Revere Frothingham, A.M., S.T.B.
George Foot Moore, D.D.

On May 10, 1886, a vote was passed by the President and Fellows "That five preachers to the University be annually appointed by the President and Fellows, with the concurrence of the Board of Overseers, who, in conjunction with the Plummer Professor of Christian Morals, shall arrange and conduct the religious services of the University." The Board of Overseers concurred in this vote on May 12, 1886, and in 1892 it was incorporated in the Statutes of the University.

On June 14, 1886, on the unanimous recommendation of the Preachers and the Plummer Professor, the President and Fellows voted "That the statute numbered 15, concerning religious exercises, be amended by striking out the clause, 'at which the attendance of the students is required'"; and on June 16 the Board of Overseers concurred in this vote. Attendance at the religious services of the University was thus, by the advice of those who conduct these services, made wholly voluntary.

The services in the University Chapel are directed by the Board of Preachers as follows: Each conducts daily morning prayers for about three weeks in each half-year, and each preaches on four Sunday evenings. The Preacher conducting morning prayers is in attendance every morning during his term of duty at Wadsworth House 1, and is at the immediate service of any student who may desire to consult him. On Thursday afternoons from November till May, vesper services are held in the University Chapel. These services are brief, largely musical, and with an address from one of the Preachers. Services on Sunday evenings are conducted by preachers of various communions by invitation of the Board of Preachers. The following invited preachers, in addition to the regularly appointed Board, conducted services during the year 1902–03:—

Rev. P. R. Frothingham, of Boston.
Rt. Rev. William Lawrence, D.D., of Boston.
Rev. President W. H. P. Faunce, D.D., of Providence, R.I.
Professor Henry Van Dyke, D.D., of Princeton, N.J.
Rev. Edward Everett Hale, D.D., of Boston.
Rev. David H. Greer, D.D., of New York, N.Y.
Rev. F. O. Hall, D.D., of New York, N.Y.
Rev. Lyman Abbott, D.D., of New York, N.Y.
Rev. President George E. Merrill, D.D., of Colgate University.
Rev. Samuel A. Eliot, D.D., of Boston.
Rev. W. F. McDowell, D.D., of New York, N.Y.
Rev. Professor E. C. Moore, D.D., of Cambridge.
Rev. Sherrard Billings, of Groton.
Rev. James Eells, of Boston.

The Preachers are glad to have their attention called to any cases of special need where they may be useful, or to any better methods of serving the moral and religious interests of the University. General correspondence for the current academic year should be addressed to the Plummer Professor, though any Preacher will gladly consider such questions as may be more appropriately addressed to him.

The Phillips Brooks House, a memorial of the late Bishop of Massachusetts, now provides a well-equipped building for the accommodation and work of the Religious Societies of the University and for the encouragement of philanthropic activity on the part of students.

In addition to the opportunities for worship in Appleton Chapel, seats are provided for students, at the expense of the College, in the churches of the different denominations in Cambridge. St. John's Memorial Chapel of the Episcopal Theological School having been erected for the especial accommodation of Harvard students is free to them.

THE UNIVERSITY LIBRARY

COUNCIL.

Charles William Eliot, LL.D., *President.*

William Coolidge Lane, A.B., *Librarian.*

Charles Eliot Norton, LL.D., *Professor of the History of Art, Emeritus.*

Crawford Howell Toy, LL.D., *Professor of Hebrew.*

William Morris Davis, M.E., *Professor of Geology.*

Charles Gross, Ph.D., *Professor of History.*

Morris Hicky Morgan, LL.D., *Professor of Classical Philology.*

George Lyman Kittredge, LL.D., *Professor of English.*

COLLEGE LIBRARY.

William Coolidge Lane, A.B., Librarian, and *Keeper of the University Records.*

William Hopkins Tillinghast, A.B., *Assistant Librarian.*

Thomas J Kiernan, A.M., *Superintendent of Circulation.*

Alfred Claghorn Potter, A.B., *Ordering Department.*

Frank Carney, *Shelf Department.*

—— —— ——, *Superintendent of Reading Room.*

Thomas Franklin Currier, A.B., *Catalogue Department.*

Percy Harrington Tufts, A.B., *Assistant in Ordering Department.*

Malcolm Storer, M.D., *Curator of Coins.*

Harry Nelson Gay, A.M., *Curator of Italian History of the Nineteenth Century.*

Edgar Huidekoper Wells, A.B., *Curator of Modern English Literature.*

Hiram Bingham, A.M., *Curator of South American History and Literature.*

James Atkins Noyes, Ph.B., A.B., *Editor of the Quinquennial Catalogue.*

The College Library in Gore Hall is for the use of the whole University. All students who have given bonds may take out books, three volumes at a time, and may keep them one month. Officers of the University have direct access to the shelves in all parts of the library, and students engaged in advanced work, upon recommendation by their instructors, are allowed access to those parts of the collection with which they are occupied. All students have the direct use of about 22,500 volumes in the reading room and the adjoining rooms. Of these 3200 are bound periodicals, 4400, miscellaneous reference books, 4800, government documents, and over 10,000 are books withdrawn from time to time from general circulation at the request of instructors and "reserved" on shelves in the reading room for use in connection with the courses of instruction. Students who leave Cambridge for an absence of more than one week must first return all borrowed books.

The College Library is open every week-day for the delivery of books, from 9 A.M. to 5.30 P.M., except Thanksgiving day, Christmas day, the Twenty-second of February, Patriots' day, Memorial day, the Fourth of July, and Labor day. The Reading Room is open from 9 A.M. to 10 P.M. During the summer vacation the library closes at 5.30 P.M., on Saturday at 1 P.M. On Sundays during term time the Library is open, for readers only, from 1 to 5.30 P.M.

The College Library may be consulted by anyone, when properly introduced, whether connected with the University or not. The privilege of borrowing books is also granted, under special regulations, to persons not connected with the University. *Blanks for making applications for such use may be had of the Librarian.*

SPECIAL LIBRARIES.

In addition to the College Library in Gore Hall, the University Library embraces the libraries of the several departments of the University, which are classed as Departmental Libraries, and a number of Special Reference Libraries maintained in the various branches of study pursued under the direction of the Faculty of Arts and Sciences.

The Departmental Libraries are in charge of the Deans and Directors of the several departments, or of Librarians named in the lists of officers of the departments. The Special Reference Libraries, with the names of their librarians, are enumerated (with some of the Departmental Libraries) on pages 474, 475.

Persons entitled to use the College Library can have access to the Departmental Libraries by applying to the Superintendent of Circulation at Gore Hall; but such libraries are primarily for the special use of the schools and departments, and are placed in the buildings belonging to such schools and departments.

The several libraries now contain about the following numbers of bound volumes: —

Gore Hall	416,000
Law School	75,900
Divinity School	33,200
Medical School (Boston)	2,400
Dental School (Boston)	700
Bussey Institution (Jamaica Plain)	4,400
Museum of Comparative Zoölogy	38,100
Peabody Museum	3,000
Phillips Library (Observatory)	10,800
Gray Herbarium	8,400
Arnold Arboretum (Jamaica Plain)	9,600
Twenty-eight Special Reference Libraries*	37,200
	639,700

The College Library has also some 280,000 pamphlets, a collection of maps numbering about 20,200 sheets, and a collection of coins. The departmental libraries have also considerable numbers of pamphlet monographs on subjects connected with their specialties; and these are not included in the count of volumes.

The catalogue of the Gore Hall Collection, including pamphlets, is on cards, accessible to the public, and consists of two parts, the one arranged by authors, the other by subjects. Printed strips of titles added to all the libraries are issued two or three times a week; and they are posted in Gore Hall and in the departmental libraries. A series of "Bibliographical Contributions" is in course of publication. Fifty-five of such publications have already been issued. More extensive bibliographical works constitute another series, "Special Publications," of which Scudder's "Catalogue of Scientific Serials" (1633–1876, 8vo, pp. 370) makes No. 1, published in 1879, and "An Index to the Subject Catalogue of Harvard College Library" makes No. 2, published in 1891. A Supplement to the same Index published in 1900 is No. 3. There has also been issued a Catalogue of the Gray Collection of Engravings (4to, 1869); this collection is in the Fogg Museum of Art.

The Librarian has the custody of the Archives of the University, as well as of the University Collection, which includes printed material of all sorts, illustrating the history of the College and University.

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* For a list of these Special Libraries see page 474 University Catalogue.

LABORATORIES.

THE CHEMICAL LABORATORY.

OFFICERS.

Charles Robert Sanger, Ph.D., Director, and *Professor of Chemistry.*

Charles Loring Jackson, A.M., *Erving Professor of Chemistry.*

Theodore William Richards, Ph.D., *Professor of Chemistry*, and *Chairman of the Division of Chemistry.*

Otis Fisher Black, A.M., *Assistant to Director.*

Henry Augustus Torrey, Ph.D., *Instructor in Organic Chemistry.*

Gregory Paul Baxter, Ph.D., *in charge of Library and of Summer Courses in Chemistry*, and *Instructor in Analytical Chemistry.*

Gilbert Newton Lewis, Ph.D., *Instructor in Physical Chemistry.*

Hans Hugo Pringsheim, Ph.D., *Instructor in Industrial Chemistry.*

Roger Clark Wells, A.B., *Instructor in Physical Chemistry.*

Arthur Dickinson Wyman, A.M., *Assistant in Descriptive Chemistry.*

George Shannon Forbes, A.B., *Austin Teaching Fellow in Physical Chemistry.*

John Frank Langmaid, A.M., *Assistant in Qualitative Analysis.*

Frederick William Russe, A.M., *Austin Teaching Fellow in Organic Chemistry.*

Roger Castle Griffin, A.B., *Assistant in Quantitative Analysis.*

Harry Louis Frevert, *Assistant in Quantitative Analysis.*

The Division of Chemistry of the Faculty of Arts and Sciences occupies the whole of Boylston Hall.

Boylston Hall was erected in 1857 with a fund bequeathed by the late Ward Nicholas Boylston, which was subsequently largely increased by subscription. The hall was enlarged by the addition of a third story in 1870, and the accommodations were still further extended in 1891 and 1902. Besides several private laboratories and preparation rooms, the building contains nine large laboratories for students. A room on the upper story with one hundred and ninety-six places is especially devoted to qualitative analysis. A large laboratory at the west end is fitted with all the modern appliances for the study of organic chemistry; there is also a room for work in advanced quantitative analysis. On the lower story a laboratory with forty-four places is reserved wholly for quantitative work, and connected with it is a laboratory especially fitted up for advanced work in inorganic chemistry. On the same story are three rooms devoted to work in physical chemistry. In the basement are two laboratories for work in descriptive chemistry with four hundred and ninety-two places. On the second story are three lecture-rooms, a reading-room, departmental library, and a chemical museum.

All the courses of instruction in Chemistry to students of Harvard College, of the Lawrence Scientific School, and of the Graduate School, are given in Boylston Hall. The laboratories are open to Special Students to follow any line of chemical investigation. The facilities for research are unusually great.

THE JEFFERSON PHYSICAL LABORATORY.

OFFICERS.

John Trowbridge, S.D., Director, and *Rumford Professor and Lecturer on the Application of Science to the Useful Arts.*

Edwin Herbert Hall, Ph.D., *Professor of Physics.*

Benjamin Osgood Peirce, Ph.D., *Hollis Professor of Mathematics and Natural Philosophy.*

Wallace Clement Sabine, A.M., *Assistant Professor of Physics.*

George Washington Pierce, Ph.D., *Instructor.*

Theodore Lyman, Ph.D., *Instructor.*

Harry Wheeler Morse, Ph.D., *Instructor.*

Charles Hamilton Ayres, Ph.D., *Instructor.*

Schuyler B Serviss, A.M., *Assistant.*

George W. Thompson, *Mechanician.*

Wilhelm E. Oelling, *Glass-blower.*

In 1881, Mr. Thomas Jefferson Coolidge, of Boston, of the Class of 1850, Minister to France 1888–96, gave $115,000 to the College for a new Physical Laboratory, on condition that $75,000 should be raised by subscription and the income appropriated to its support. He has also given a fund for original research which yields $2500 a year. There is also a fund for original research entitled the JOSEPH LOVERING fund which yields between $300 and $400 a year. The building was finished in October, 1884, and is called the Jefferson Physical Laboratory. All the instruction in Physics, by recitations, lectures, and experimental work, to students of Harvard College, of the Lawrence Scientific School, and of the Graduate School, is given in this building, which accommodates the various physical cabinets. The building is four stories high, if the basement is included. In the eastern wing the whole height is divided between a large lecture-room below, and the great laboratory above. In the central and western portions of the building are three recitation-rooms for sections of forty or less; but the principal part of the central and western portions is broken up into a large number of small rooms, where the professors, assistants, and advanced students can pursue their separate investigations, and be secured against intrusion, or any disturbance of their instruments. In the basement and first story, stone tables, each supported by its own column of masonry, and without contact with the floors, furnish firm support for these instruments. In the centre of the western wing a large rectangular tower stands on an independent foundation, and is isolated from the surrounding rooms. It is designed for investigations which demand extraordinary stability, or a great height: as in Foucault's pendulum-experiment. Small openings have been left in the brick partitions which divide the length of the building, by means of which a long path is available for such experiments as that on the velocity of light. In the western wing, iron nails and pipes, which would disturb delicate experiments in magnetism, were excluded in the construction of the building. In the bottom of the tower is a small underground room which may be used for experiments requiring a constant temperature.

A room is devoted to the accurate measurement of electrical resistances and is provided with standard coils.

A comparator for the measurement and comparison of standards of length occupies a room in the basement of the Laboratory.

The photographic room adjoins a large space on the fourth floor, which contains the rooms especially arranged for spectrum analysis. There are four principal laboratory rooms. One of these is 40x60 feet and is devoted to elementary laboratory instruction. The laboratory for advanced instruction in electricity is in the basement and is provided with instruments of the latest type. A machine room is supplied with power from an electric motor. In this room is a milling machine, a large machine lathe, a smaller lathe, and other mechanical appliances for designing and making apparatus. The machine room is under the charge of a skilled mechanician. Power can also be obtained from a twenty-five-horse-power engine which is placed in a house outside of the Laboratory.

MUSEUMS.

The University has the following Museums:—

The University Museum, including Natural History Collections and Laboratories, the Semitic Museum, the William Hayes Fogg Museum of Art, and the Germanic Museum, all situated in Cambridge. The University also possesses museums at the Medical School, at the Dental School, and at the Arnold Arboretum.

THE UNIVERSITY MUSEUM.

DIRECTOR.

Alexander Agassiz, LL.D.

COMMITTEE.

Alexander Agassiz, LL.D.
Henry Pickering Walcott, M.D.
George Lincoln Goodale, M.D., LL.D.
Frederic Ward Putnam, A.M., S.D.
William Morris Davis, M.E.
Edward Laurens Mark, Ph.D., LL.D.
John Eliot Wolff, Ph.D.
William McMichael Woodworth, Ph.D.

The University Museum building consists of a Central division, a North wing, and a South wing; the latter not yet completed.

In this building are the Zoölogical section, known as the Museum of Comparative Zoölogy, the Botanical section, the Mineralogical section, the Geological section, and the Anthropological section, known as the Peabody Museum of American Archaeology and Ethnology. Each section contains exhibition rooms open to the public, storage collections for scientific research, and laboratories for students and investigators.

The entrances to the Museum of Comparative Zoölogy and the Peabody Museum are from Divinity Avenue. The entrance to the Central section is from Oxford Street.

The Museum of Comparative Zoölogy occupies the whole of the North wing and part of the Central division. The Zoölogical and Palaeontological Laboratories are in the part of the Central division contiguous to the Museum of Comparative Zoölogy. The Botanical section, the Mineralogical section, and the Geological section follow in the Central division in the order named. The Peabody Museum occupies the South wing of the building as far as built.

ASSOCIATES OF THE UNIVERSITY MUSEUM.

Honorary appointments to the position of Associate of the University Museum are made by the Corporation on nomination of the Committee on the University Museum. Associates are persons qualified for and engaged in research or exploration independent of other educational or scientific associations.

Andrew Gray Weeks, Jr., *Associate in Entomology.*
Adolph Hempel, *Associate in Zoölogy.*

THE MUSEUM OF COMPARATIVE ZOÖLOGY.

FACULTY.

Charles William Eliot, A.M., LL.D., President.
——— ———, Curator.
George Lincoln Goodale, M.D., LL.D. }
Henry Pickering Walcott, A.B., M.D. } *Committee on the Museum.*
Alexander Agassiz, LL.D., *Secretary.*

OFFICERS.

William McMichael Woodworth, Ph.D., *Keeper.*
William Morris Davis, M.E., *Sturgis-Hooper Professor of Geology.*
Walter Faxon, S.D., *Assistant in charge of Mollusca and Crustacea.*
Samuel Garman, A.M., *Assistant in Herpetology and Ichthyology.*
William Brewster, A.M., *Assistant in Ornithology.*
Samuel Henshaw, A.M., *Assistant in Entomology,* and *Librarian.*
Charles Rochester Eastman, Ph.D., *Assistant in Vertebrate Palaeontology.*
Outram Bangs, *Assistant in Mammalogy.*
Frances Mary Slack, *Librarian Emerita.*
Magnus Westergren, *Artist.*
George Nelson, *Preparator.*

The Museum of Comparative Zoölogy was founded in 1859 by private subscription with the assistance of the State of Massachusetts. In 1876 the property in the hands of the Trustees was transferred to the President and Fellows of Harvard College.

The Museum is under the management of a Faculty, who nominate the Curator and the Sturgis-Hooper Professor, and appoint the Assistants.

The Curator is charged with the direction of the scientific and educational interests of the Museum, as well as of its relations to the public.

The Exhibition Rooms open to the public are the Synoptic Room, the rooms containing the various systematic collections, those devoted to the various faunal collections (Europe, North and South America, Indo-Asia, Africa, Australia, and the Atlantic and Pacific Oceans); also the rooms devoted to special collections and to the Quaternary, Tertiary, and Mesozoic fossils.

The collections are open, Christmas and the Fourth of July excepted, every week-day, from 9 A.M. till 5 P.M., and on Sunday, from 1 P.M. till 5 P.M. Entrance on the south side of the North wing.

The publications of the Museum consist of an annual Report (1861–1902), of an octavo Bulletin (vols. i.–xli.), and of Memoirs in quarto (vols. i.–xxviii.). The Bulletin and Memoirs are devoted to the publication of original work by the Officers of the Museum, of investigations carried on by Professors, Students and others in the different laboratories of Natural History, and of work by Specialists based upon the Museum collections and explorations.

The Library of the Museum is on the second floor of the north end of the central section of the University Museum. It contains over 34,000 volumes, exclusive of a part of the Whitney Library, and of about 28,000 pamphlets. The Library is open, daily except Sunday, from 9 A.M. to 5 P.M.

LABORATORIES OF ZOÖLOGY AND PALAEONTOLOGY.

The Laboratories of Zoölogy and Palaeontology are in the north end of the Central section of the University Museum.

The courses of instruction in the various branches of Zoölogy, including Palaeontology, are given in the Zoölogical and Palaeontological laboratories.

The Assistants of the Museum also receive specialists in their respective departments.

Two of the tables of the U. S. Fish Commission Station at Wood's Hole are at the disposal of the Faculty of the Museum, to whom application should be made before the first of May. Candidates should specify their qualifications and the work they intend to carry on.

The income of the Humboldt Fund (about $400) is applied, with the advice of the Faculty of the Museum of Comparative Zoölogy, towards the maintenance of one or more persons engaged in study at the Museum, at the Wood's Hole Fish Commission Station, at the Bermuda Biological Station for Research, or at the Tortugas. This fund, now amounting to about eight thousand dollars, was given to the Trustees of the Museum by the BOSTON SOCIETY OF NATURAL HISTORY in November, 1869. It was derived from the proceeds of a celebration, held in Boston in 1869, the year of the centennial anniversary of the birth of ALEXANDER VON HUMBOLDT, augmented by a special subscription and by money received from the sale of an address delivered by Professor LOUIS AGASSIZ on the occasion of the celebration.

The VIRGINIA BARRET GIBBS SCHOLARSHIP, of the value of $250, is assigned annually with the approval of the Faculty of the Museum on the recommendation of the Professors of Zoölogy and of Comparative Anatomy in Harvard University "in supporting or assisting to support one or more students who may have shown decided talents in Zoölogy and preferably in the direction of Marine Zoölogy."

THE ZOÖLOGICAL LABORATORIES.

OFFICERS.

EDWARD LAURENS MARK, Ph.D., LL.D., DIRECTOR, and *Hersey Professor of Anatomy.*
ROBERT TRACY JACKSON, S.D., *Assistant Professor of Palaeontology.*
GEORGE HOWARD PARKER, S.D., *Assistant Professor of Zoölogy.*
WILLIAM ERNEST CASTLE, Ph.D., *Assistant Professor of Zoölogy.*
ALEXANDER PETRUNKEVITCH, Ph.D., *Lecturer on Cytology.*
ARTHUR DAY HOWARD, S.M., *Austin Teaching Fellow in Zoölogy.*
LEON JACOB COLE, A.B., *Austin Teaching Fellow in Zoölogy.*

The Zoölogical Laboratories were moved in the autumn of 1883 from the east end of the North wing into the north end of the Central section of the Museum, built by Mr. ALEXANDER AGASSIZ to accommodate the laboratories of Natural History. The following rooms are now occupied. On the fifth floor a large room for research work; on the fourth four laboratories and lecture rooms, and four private rooms for instructors; on the first a lecture room seating 300, and three laboratories and lecture rooms; in the basement, above ground, two rooms for experimental and breeding purposes, an aquarium room and a vivarium room, furnished with the necessary aquaria, aerating apparatus, cages, and pens, a room for photographic work and experiments involving the use of special light appliances, a photographic dark room, and a work shop. All the ordinary apparatus for carrying on investigations, as well as for class work, are regularly assigned to students, and special needs are met as occasions arise. The books most needed in connection with class instruction are in both the Library of the Zoölogical Laboratory and the Museum Library. For the zoölogist there are probably no better library facilities in America than those of Boston and Cambridge. The results of the investigations carried on in the Laboratory are published as "Contributions from the Zoölogical Laboratory," mostly in the Bulletin of the Museum of Comparative Zoölogy, and a list of them is printed annually in the reports of the President of the University and of the Keeper of the Museum. The facilities offered to students in Zoölogy for work at the seashore are stated on page 679 of the University Catalogue.

THE BOTANICAL MUSEUM.

OFFICERS.

George Lincoln Goodale, M.D., LL.D., *Fisher Professor of Natural History.*

William Gilson Farlow, M.D., LL.D., *Professor of Cryptogamic Botany.*

Robert Tracy Jackson, S.D., *Assistant Professor of Palaeontology.*

Arthur Bliss Seymour, S.M., *Assistant in Cryptogamic Herbarium.*

Rudolph Blaschka, *Artist-naturalist.*

The collections at present accessible to the public are on the third floor of the central section of the University Museum and on the landing of the first floor. They are designed to illustrate the principal systematic, biological, and economic relations of plants. The large and increasing Ware Collection of glass models of flowers, prepared by the artists, Leopold and Rudolph Blaschka of Germany, occupies the large exhibition room. Contiguous rooms contain collections of economic products, and on the landing of the first floor is to be found a collection of Cryptogams. In the basement is stored the large collection of Fossil plants, now in process of arrangement.

LABORATORIES
OF CRYPTOGAMIC AND PHANEROGAMIC BOTANY.

OFFICERS.

George Lincoln Goodale, M D., LL.D., *Fisher Professor of Natural History.*

William Gilson Farlow, M.D., LL.D., *Professor of Cryptogamic Botany.*

Roland Thaxter, Ph.D., *Professor of Cryptogamic Botany.*

Benjamin Lincoln Robinson, Ph.D., *Asa Gray Professor of Systematic Botany* and *Curator of Gray Herbarium.*

Edward Charles Jeffrey, Ph.D., *Assistant Professor of Vegetable Histology.*

Jesse More Greenman, Ph.D., *Instructor in Botany* and *Assistant in the Gray Herbarium.*

Merritt Lyndon Fernald, S.B., *Instructor in Botany* and *Assistant at the Gray Herbarium.*

Oakes Ames, A.M., *Instructor in Botany* and *Assistant Director of the Botanic Garden.*

Amon Benton Plowman, A.M., *Assistant in Botany.*

Arthur Houston Chivers, A.M., *Austin Teaching Fellow in Botany.*

Joseph Abraham Long, S.B., *Austin Teaching Fellow in Botany.*

The Cryptogamic Laboratories occupy the whole of the fifth floor (60 x 120 feet). Here is also kept the extensive Herbarium of Algae, Fungi, Lichens, Mosses, and Hepatics. Those desiring to consult the Herbarium should apply to Professor Farlow.

The Laboratories of Phanerogamic Botany are on the second floor, and are supplemented by private workrooms in other parts of the botanical section.

The N. C. Nash Botanical Lecture-room, the gift of a graduate in memory of his father, is on the first floor of the Museum.

THE MINERALOGICAL MUSEUM.

CURATOR.

John Eliot Wolff, Ph.D., *Professor of Petrography and Mineralogy.*

The mineralogical section of the University Museum, built in 1890–91 with a fund of about $50,000, raised wholly by subscription, forms the southern-central part of the University Museum. Entrance is by the middle door on Oxford Street.

The exhibition room and gallery occupy the third and fourth floors and are open to the public on Wednesday and Sunday afternoons from 1 to 5, and Saturday from 9 to 5.

The main mineralogical collections of the University are deposited here; they contain on the ground floor and gallery the large systematic collection with special features and collections, such as the J. Lawrence Smith collection of meteorites, the William Sturgis Bigelow agates, the Hamlin collection of tourmalines, and many unique specimens presented by James A. Garland and others.

MINERALOGICAL LABORATORIES.

OFFICERS.

Theodore W. Richards, A.M., *Professor of Chemistry.*
Charles Palache, Ph.D., *Assistant Professor of Mineralogy.*
—— —— ——, A.B., *Assistant in Mineralogy and Petrography.*

The Laboratories of Mineralogy and Petrography occupy basement, first and second floors, and contain a laboratory for advanced crystallographic investigation and optical mineralogy on the second floor; the large lecture-room, general laboratory for elementary mineralogy and blow-pipe analysis, special laboratory and library on the first floor, and in the basement a chemical laboratory equipped for mineral and rock analysis, and a work shop.

The courses in mineralogy, crystallography, and petrography are given in these laboratories, where the instructors also receive properly qualified students who wish to follow special lines of mineralogical research.

THE GEOLOGICAL MUSEUM.

The Geological section of the University Museum was built in 1900–01 by the family of Mr. Agassiz and forms the southeastern corner of the building, with entrances from Oxford Street and Divinity Avenue.

The exhibition rooms are on the third floor: they are not yet arranged, but the Curtis model of the Boston Metropolitan district, exhibited in Paris in 1900 and afterwards presented to the University by the Commonwealth, may be seen in the southwest room.

GEOLOGICAL AND GEOGRAPHICAL LABORATORIES.

OFFICERS.

Nathaniel Southgate Shaler, S.D., LL.D., *Professor of Geology.*
William Morris Davis, M.E., *Sturgis Hooper Professor of Geology.*
Robert Tracy Jackson, S.D., *Assistant Professor of Palaeontology.*
Robert DeCourcy Ward, A.M., *Assistant Professor of Climatology.*
Jay Backus Woodworth, S.B., *Assistant Professor of Geology.*
Thomas Augustus Jaggar, Jr., Ph.D., *Assistant Professor of Geology.*
Philip Sidney Smith, A.M., *Instructor in Geology.*

The first floor of the Geological section contains a large lecture room and a professor's room. The Gardner Collection of Geological and Geographical photographs is kept in cases in the hall. The second floor contains a geological laboratory, especially designed for large classes of beginners: sixty-four students can be seated at the work-tables. A professor's room adjoins the laboratory. The fourth floor contains a large geographical laboratory, with adjoining rooms for smaller classes in physiography and climatology. The fifth floor is chiefly devoted to students in field geology; but contains also a small lecture room and a room at present used for experimental geology, for which there is an additional well-lighted room in the basement.

THE PEABODY MUSEUM

OF

AMERICAN ARCHAEOLOGY AND ETHNOLOGY.

FACULTY.

Charles William Eliot, A.M., LL.D., President.
Frederic Ward Putnam, A.M., S.D., Secretary.
Stephen Salisbury, A.M., LL.B.
Charles Pickering Bowditch, A.M.
Francis Cabot Lowell, A.B.

OFFICERS.

Frederic Ward Putnam, A.M., S.D., Curator.
Charles C. Willoughby, *Assistant Curator.*
Alice C. Fletcher, *Assistant in Ethnology* (Holder of the Thaw Fellowship).
Zelia Nuttall, *Honorary Assistant in Mexican Archaeology.*
Jane Smith, *Assistant Librarian.*
Frances H. Mead, *Assistant* and *Secretary.*
David I. Bushnell, Jr., *Assistant in Archaeology.*

LABORATORIES OF ARCHAEOLOGY AND ETHNOLOGY.

OFFICERS.

Frederic Ward Putnam, A.M., S.D., *Peabody Professor of American Archaeology and Ethnology.*
Roland Burrage Dixon, Ph.D., *Instructor in Anthropology.*
William Curtis Farabee, Ph.D., *Instructor in Anthropology.*

The Peabody Museum, which is the anthropological section of the University Museum, was founded by George Peabody in 1866. In January, 1897, the Trustees of the Museum transferred the property held by them to the President and Fellows of Harvard College. The entrance to the Museum is from Divinity Avenue. The present building is one half of the contemplated structure which will form the southern wing of the University Museum. The Museum is in charge of the Curator, and is open to the public, under proper restrictions, from 9 a.m. to 5 p.m. (or until dark) throughout the year, Sundays and holidays excepted. The arrangement of the collections is intended to facilitate research in General Anthropology with special reference to American and Comparative Archaeology and Ethnology.

With the exception of the human crania and skeletons in the upper halls, the collections are so arranged that those from each limited region are brought together. Thus, in the large hall on the first floor and in the gallery above are the exhibits illustrating the life and customs of many of the tribes of North American Indians. In the Warren Ethnological Gallery are the Polynesian, Melanesian, Asiatic, and African collections. The Mary Hemenway collection from Arizona occupies one of the upper halls and a gallery on the floor below. The exhibits from Peru and other parts of South America are in a hall on the second floor. Those from Mexico and Central America, including the casts of large sculptures from the ruins of Copan and Quirigua, many original stone sculptures, pottery, ornaments, and other objects, secured by the Museum expeditions to Honduras, Guatemala and Yucatan, are in the central hall and large room on the second floor. In another hall are the comparative exhibits of the St. John's, the Delaware, and the Little Miami valleys. The collections from the mounds and earthworks are in a hall on the first floor. In another room are the exhibits from the Swiss lakes, from the French caves, and from Denmark and other European localities.

The Anthropological Library, containing 2,969 volumes and 2,813 pamphlets, is open to members of the University. The publications of the Museum consist of Annual Reports, Special Papers, and Memoirs.

In the laboratories and lecture rooms of the Museum regular College courses of instruction are given in several branches of Anthropology. Research courses in Archaeology, Ethnology, and Somatology are open to students in the Graduate School and, by special permission, to properly qualified undergraduates. (See page 455.)

The Serpent Mound Park in Adams County, Ohio, which contains the ancient earthwork known as the Serpent Mound, has been transferred to the Ohio State Archaeological and Historical Society for perpetual care as a public park.

In addition to the scholarships and fellowships annually awarded to Graduate Students on nomination by the Faculty of Arts and Sciences, the following are available only for students in the Division of American Archaeology and Ethnology, and are awarded on nomination by the Faculty of the Peabody Museum: — The Hemenway Fellowship, the Thaw Fellowship, and the Winthrop Scholarship. The incomes of the Huntington-Frothingham-Wolcott Fund, the Henry Warren Fund, and the Mrs. S. D. Warren Fund are available for special research in the field under the direction of the Curator.

THE SEMITIC MUSEUM.

CURATOR.

David Gordon Lyon, Ph.D., D.D., *Hollis Professor of Divinity.*

The Semitic Museum was founded by Jacob H. Schiff, Esq., who in 1889 gave $10,000 for this object. The collections bought with this money occupied until 1902 a room in the Peabody Museum, where they were formally opened on May 13, 1891. The objects aimed at have been to aid the regular instruction given in the department; to furnish the means of research; to illustrate the manners, customs, and history of the Semitic peoples; and thus to show, as far as may be, what the Semites have contributed to civilization.

Besides the $10,000 Mr. Schiff has made various additional contributions to the collections. Other friends have likewise made valuable gifts. and in 1899 about one hundred of these gave the sum of $19,240 to make further purchases.

The Museum Building, on Divinity Avenue, is likewise the gift of Mr. Schiff. It was completed in 1902, and has cost with furniture and cases about $80,000. It is the home of the Semitic instruction, the departmental library, and the collections.

On the first floor is the library, also three lecture rooms, seating 20, 50, and 165 persons respectively.

On the second floor are the Curator's room and a room for exhibits, about 80 by 50 feet. The latter is the Assyrian room, and contains the large collection of casts of Assyrian, Babylonian, and Hittite bas-reliefs and monuments, from originals in London, Paris, Berlin, and Constantinople; the stone and clay tablets written in cuneiform; the cylinder seals; and other objects in bronze, clay, and stone of Babylonian-Assyrian origin.

On the third floor is the Palestinian exhibition room, of the same size as the Assyrian room, also a smaller room about 18 x 20 feet. The Palestinian room contains the objects from Palestine proper, Moab, Arabia, Egypt, Phoenicia, Syria, and Persia; such as stone inscriptions, manuscripts, coins, pottery, glass vases, bronzes, bas-reliefs, sarcophagi, models, costumes, photographs, and specimens of natural history (geology, flora, fauna), etc.

So far as practicable the arrangement in both rooms is geographical, chronological, and topical. The Museum was formally opened on February 5, 1903. It is open to visitors on week-days from 9 a.m. to 5 p.m.

THE WILLIAM HAYES FOGG ART MUSEUM.

DIRECTOR.

Charles Herbert Moore, A.M., *Professor of Art.*

The William Hayes Fogg Art Museum was founded by Mrs. Elizabeth Fogg of New York in memory of her husband, whose name it bears. Mrs. Fogg bequeathed to the President and Fellows for this purpose the sum of $220,000. Of this amount $150,000 was expended on the handsome fire-proof building which was completed in 1895 and is situated in the College Yard facing on Broadway. The building is of two stories, with a large lecture room, having a seating capacity of about five hundred, attached. On the ground floor is a large hall for casts, with five smaller rooms for casts and other objects. The upper floor has a large gallery and four smaller rooms for the exhibition of works of art and for administration. The collections thus far consist of casts from important works in sculpture of the ancient, mediaeval, and Renaissance epochs, a classified collection of electrotypes from Greek and Roman coins, a small series of Greek vases, and a large and growing collection of photographs of works of art of all epochs and countries, including architecture, sculpture, and painting. These photographs are conveniently classified and catalogued; and are at all times accessible to members of the University and other visitors.

In the larger east room on the upper floor is deposited the Gray Collection of Engravings. This important and very valuable collection was bequeathed to Harvard College, with provision for its increase and maintenance, by the Hon. Francis Calley Gray, LL.D., of the Class of 1809. It was first deposited in Gore Hall under the care of Mr. Louis Thies, who prepared and published an elaborate Catalogue, which forms a quarto volume of 530 pages. On the death of Mr. Thies, Dr. Ezra Abbott became its custodian; and later the Corporation appointed Mr. (now Professor) George H. Palmer its curator. On the completion of the building of the Boston Museum of Fine Arts (the College having as yet no suitable place for its safe keeping and administration), it was loaned, for a term of seven years, to the Trustees of that institution and removed to Boston. Its first custodian in Boston was Mr. Erastus Brainerd, who was succeeded by Mr. E. H. Greenleaf. Later, it passed into the able curatorship of Mr. S. R. Koehler. The loan to the Trustees of the Boston Museum of Fine Arts was twice renewed, and in the autumn of 1897 the Corporation caused the collection to be returned to Cambridge and deposited in its present safe and convenient quarters under the care of the Director of the Museum —where it is always accessible to members of the University and to the public.

The Fogg Museum also contains the RANDALL COLLECTION OF ENGRAVINGS, which was bequeathed to Harvard College by the late JOHN WITT RANDALL, A.M., M.D., of the Class of 1834. This collection includes about twenty thousand prints and drawings; and is accessible at all times under the rules and regulations which apply to the Gray Collection.

In addition the Museum has lately acquired, as an indefinite loan, a select collection of original works of art, among which are: A Greek marble statue of Meleager, found near Rome in 1895 (an example of the finest Greek sculpture of the 4th century B.C.); a Greco-Roman sarcophagus relief in marble representing a Battle of Amazons; a small Aphrodite head in marble; a Florentine *Tabernacolo* of the 15th century in tempera; an Adoration of the Magi of the school of Ferrara (also of the 15th century); a portrait of a Procurator of St. Mark, a Venetian oil painting of the 16th century, having the characteristics of the work of Tintoretto; and several other important original works of Italian painting and ancient sculpture. And, as a gift from members of the Class of 1895, a marble statue of Aphrodite, which is a very beautiful original work of Greek sculpture.

The Museum has lately been further enriched by a choice collection of ancient Greek vases, bronzes, and gold ornaments; and by several fine water color drawings by J. M. W. Turner.

The Museum is open daily from 9 until 5 o'clock. On Sundays it is open from 1 until 5 in the afternoon.

THE GERMANIC MUSEUM.

CURATOR.

KUNO FRANCKE, Ph.D., *Professor of German Literature.*

The GERMANIC MUSEUM was established in 1902, as the result of collections undertaken by the Visiting Board of the Germanic Department and by the Germanic Museum Association; but its present status is largely due to important donations received from the German Emperor and a Committee of leading German scholars, artists, and men of affairs at Berlin. The Swiss Government also has given valuable aid. The Museum is temporarily installed in the Rogers Building. Its object is to illustrate by means of plaster casts and other kinds of reproduction the outward aspect of the development of Germanic civilization.

The present collection, apart from a large number of photographs of German architectural and sculptural monuments chiefly from the Königlich Preussische Messbildanstalt, contains models and reproductions of representative works of German industry and art from the 5th to the 18th century. Among them are the following: — A model of the Nydam Boat, from the Museum of Kiel (5th century); a figure of a Frankish Warrior, from the Museum of Mainz (7th century); the Bernward Column and the bronze gates of Hildesheim Cathedral (11th century); Choir Screen of St. Michael's at Hildesheim (12th century); the Golden Gate of Freiberg Cathedral (13th century); statues of Emperor Henry II, Empress Kunigunde and a Sibyl from Bamberg Cathedral (13th century); the Rood-Screen and eleven Founders' statues from Naumburg Cathedral (13th century); statues of a Wise and a Foolish Virgin, of the Ecclesia and Synagoga, and of two Virtues, and a relief of the Death of Mary from Strassburg Cathedral (13th century); the Praying Virgin of the Germanic Museum at Nürnberg (15th century); figure of a Swiss Warrior from a fountain at Schaffhausen (16th century); Peter Vischer's Tomb of St. Sebald's at Nürnberg, Tomb of Count and Countess of Henneberg at Römhild and statue of King Arthur at Innsbruck; statue of Emperor Maximilian from his Tomb at Innsbruck; reliefs and statuettes from Brüggemann's Altarpiece at Schleswig Cathedral; Adam Kraft's Seventh Station; Renaissance door from the Hirschvogel Saal, Nürnberg; galvanoplastic reproductions of plaquettes by Floetner and other masters of the 16th century; Andreas Schlüter's equestrian statue of the Great Elector at Berlin; Schadow's statue of Frederick the Great at Stettin; galvanoplastic reproductions of representative specimens of German gold- and silversmith's work from the 15th to the 18th century.

The Museum is open to the public Mondays and Fridays from 9 A.M. till 3.30 P.M., and Sundays from 1 till 5 P.M.

BOTANIC GARDEN AND HERBARIUM.

THE BOTANIC GARDEN.

OFFICERS.

George Lincoln Goodale, M.D., LL.D., Director, and *Fisher Professor of Natural History.*
Oakes Ames, A.M., *Assistant Director of the Botanic Garden.*
Robert Cameron, *Head Gardener.*

The Botanic Garden, founded in 1807, occupies about seven acres of land at the corner of Linnaean and Garden Streets, Cambridge. More than five thousand species of flowering plants are cultivated for educational and scientific purposes.

The range of greenhouses comprises fourteen divisions assigned respectively to: — (1) Desert plants for illustrations in ecology. (2) Cactus conservatory. (3) Economic plants. (4) Palms and their allies. (5) Mexican plants and ferns. (6) Potting shed. (7) Tropical orchids, aroids, etc. (8) Australasian plants. (9) Winter blooming roses and other decorative plants. (10), (11) Devoted to experimental work in vegetable physiology. (12) Propagating house. (13) Potting shed. (14) Devoted to the more common classes of flowering plants, and for raising Herbaceous plants.

The space at the northwestern part of the Garden is devoted to an exhibition of a large number of our North American species, with special reference to their morphology. The ground below the terrace is filled with illustrations of the Orders and principal Genera of the plants of the United States, together with species from the Old World for comparison.

The grounds and greenhouses are open to the public daily, from sunrise to sunset.

To students properly qualified, specimens of flowers and living plants are freely furnished, and facilities are offered in the laboratories in the Garden, for pursuing investigations in Morphology. Under certain restrictions, students are supplied with all necessary appliances for conducting experiments in Vegetable Physiology and its application to practical questions in horticulture.

From the first week in July until the second week in August, regular instruction in Botany is given at the Botanic Garden, in connection with the Summer School of the Faculty of Arts and Sciences.

THE GRAY HERBARIUM.

OFFICERS.

BENJAMIN LINCOLN ROBINSON, Ph.D., CURATOR, and *Asa Gray Professor of Systematic Botany.*
CYRUS GURNSEY PRINGLE, A.M., *Collector.*
MERRITT LYNDON FERNALD, S.B., *Assistant*, and *Instructor in Botany.*
JESSE MORE GREENMAN, Ph.D., *Assistant*, and *Instructor in Botany.*
MARY A. DAY, *Librarian.*

The GRAY HERBARIUM occupies a building in the Botanic Garden. The collection, presented to Harvard University in 1864 by the late Professor ASA GRAY, now contains over three hundred and fifty thousand sheets of mounted specimens and is the result of more than sixty years of continuous growth. It embraces all orders of flowering plants, ferns, and fern-allies, while the bryophytes, fungi, lichens, and algae have now been transferred to the Cryptogamic Herbarium in the Botanical Division of the University Museum. The Gray Herbarium is rich in type specimens of species and varieties, in standard and rare phaenogamic *exsiccati*, and in the possession of the greater part of the specimens which have been critically studied in the preparation of the "Synoptical Flora of North America."

The Herbarium may be consulted, under supervision of the staff, by advanced students and other properly qualified persons. Visiting specialists receive such facilities for work as can be given without interrupting the regular duties of the staff.

The Library of the Herbarium, now including more than fifteen thousand carefully selected volumes and pamphlets, is open for consultation to all persons interested in Botany.

The scientific publications of the Herbarium at present embrace the following classes of work: I. The continuation of the "Synoptical Flora of North America." II. The issue from time to time of "Contributions from the Gray Herbarium of Harvard University," a series of technical papers devoted chiefly to the characterization of new species and monographing of genera. III. The preparation of lesser articles, both technical and popular, published in various scientific journals.

The valuable local collection of the NEW ENGLAND BOTANICAL CLUB is temporarily deposited in the building of the Gray Herbarium and may, with certain restrictions, be consulted by persons interested in the flora of New England.

THE BUSSEY INSTITUTION.

The School of Agriculture and Horticulture, known as the Bussey Institution, was established in execution of trusts created by the will of Benjamin Bussey. It gives systematic instruction in Agriculture, Useful and Ornamental Gardening and Land Surveying, and in Chemistry and Natural History as applied to Agriculture, Horticulture and Forestry.

It is, in general, meant for young men who intend to become practical farmers, gardeners, florists, or landscape gardeners; as well as for those who will be called upon to manage large estates, or who wish to qualify themselves to be overseers or superintendents of farms, country seats, parks, towns, highways, or public institutions. It may serve also for the training of investigators and teachers of agricultural science, and in special cases as a school for the methodical education of young men fond of country life or interested in natural history.

The degree of Bachelor of Agricultural Science may be attained by students in the School.

The Bussey Institution is situated at the outer edge of Jamaica Plain, Massachusetts, about five miles southwest of the centre of Boston, and close to the Forest Hills station on the Boston and Providence Railroad. Although somewhat removed from the other departments of the University, it is near enough to Cambridge to enable the student, if he please, to attend a great variety of collateral instruction there given, and to make use of the College Library and the rich scientific collections of the University. The position of the School is in some part advantageous in that it helps to maintain the spirit and atmosphere proper to a School of Agriculture and insures to its younger students mental independence, freedom from distractions, and opportunity to devote themselves seriously to their chosen studies. Students may live either in the immediate vicinity of the School, or in Boston proper, or in some one of the villages upon the lines of the adjacent railways.

INSTRUCTORS.

Edmund Hersey, *Instructor in Farming*, and *Superintendent of the Bussey Farm.*

Francis Humphreys Storer, S.B., A.M., Dean, and *Professor of Agricultural Chemistry.*

Benjamin Marston Watson, A.B., *Instructor in Horticulture.*

THE ARNOLD ARBORETUM.

The Arnold Arboretum was founded in 1872, by the trustees under the will of JAMES ARNOLD, of New Bedford, for the purpose of scientific research and experiment in Arboriculture, Forestry, and Dendrology, and as a Museum of trees and shrubs suited to the climate of Massachusetts. The Arboretum occupies a portion of the Bussey Farm in West Roxbury, 220 acres in extent, and, under a special arrangement with the City of Boston, is open to the public every day in the year from sunrise to sunset. The living collections are supplemented by an Herbarium, Museum, and Library.

OFFICERS.

CHARLES SPRAGUE SARGENT, A.B., LL.D., DIRECTOR, and *Arnold Professor of Arboriculture.*

CHARLES EDWARD FAXON, S.B., A.M., *Assistant, in charge of Herbarium and Museum.*

JACKSON DAWSON, *Superintendent.*

Any one properly qualified to pursue the study of practical arboriculture or dendrology may be admitted to the Arboretum as a student. Such students will be permitted to take part in the work carried on in the Arboretum as well as to make use of its Library. They will also receive from the officers of the Arboretum such assistance and advice in the study of any branch of Arboriculture or Dendrology as can be rendered without interference with current work. In order to study with advantage in the Arboretum, the student should already possess such a degree of botanical knowledge as is implied in a thorough acquaintance with "Gray's Botanical Text Book," or any equivalent work. He must have some knowledge of horticultural methods and practice, and should be familiar with the native trees at least of the New England States.

Application for admission may be made to the Director, with whom the fees for instruction may be agreed upon. Fees may be remitted in consideration of services performed.

In the spring and autumn Mr. JOHN GEORGE JACK conducts a series of Lectures and Field Meetings on Saturday mornings for the purpose of supplying popular instruction about the Trees and Shrubs which grow in New England.

The instruction given in these meetings is not technical, and a knowledge of descriptive botany is not essential for persons who wish to follow them. The intention is to indicate by comparison the easiest means of distinguishing the common native trees and shrubs as they appear in this part of the country, and of recognizing the foreign species which have been introduced into our gardens. The ornamental and useful properties of these trees and shrubs, their habits of growth, and other peculiarities may be considered; and the species or groups are studied with reference to their aspects in spring or autumn when the courses are given.

The fee for either the spring or autumn course is *six dollars*, payable in advance. The courses are open to both men and women.

Applications or further inquiries concerning this instruction may be addressed to Mr. J. G. JACK, Jamaica Plain, Mass.

THE ASTRONOMICAL OBSERVATORY.

OFFICERS.

Charles William Eliot, A.M., LL.D., President.

Edward Charles Pickering, A.M., LL.D., Director, and *Paine Professor of Practical Astronomy.*

Arthur Searle, A.M., *Phillips Professor of Astronomy.*

Solon Irving Bailey, A.M., *Associate Professor of Astronomy.*

William Henry Pickering, S.B., *Assistant Professor of Astronomy.*

Oliver Clinton Wendell, A.M., *Assistant Professor of Astronomy.*

John Rayner Edmands, S.B., *Assistant.*

Abbott Lawrence Rotch, A.M., *Assistant in Meteorology.*

Williamina Paton Fleming, *Curator of Astronomical Photographs.*

Willard Peabody Gerrish, *Assistant.*

Edward Skinner King, A.M., *Assistant.*

John Augustine Dunne, *Assistant.*

The Astronomical Observatory was established by means of a subscription initiated in 1843. The Sears Tower was completed in 1846, and the great refractor was received at the close of the same year. In 1848, Edward Bromfield Phillips, of the Class of 1845, bequeathed to the University the sum of one hundred thousand dollars for the benefit of the Observatory. In 1885, Robert Treat Paine, of the Class of 1822, bequeathed his entire fortune, amounting to more than a quarter of a million of dollars, to the University for the Observatory.

The Observatory was founded for the purpose of scientific research in all departments of Astronomy. To fulfil this purpose, it has been equipped with instruments of the first class and with a library of thirty thousand works (of which about two thirds are pamphlets), principally relating to astronomical subjects. It has likewise been provided with funds for the maintenance and increase of its equipment and library, and for the payment of its current expenses, special provision having also been made for the publication of its observations.

One of the principal departments of the Observatory is the Henry Draper Memorial, maintained by Mrs. Draper to permit the study on a large scale of the spectra and other physical properties of the fixed stars.

The Boyden Fund furnishes the means of establishing an observing station at a considerable elevation, to avoid the serious difficulties in observation which arise from atmospheric causes. After preliminary experiments on mountains in Colorado and California, a station was established in the Andes, near Chosica, Peru, under the direction of Professor Bailey. This has been transferred to a site about 8000 feet high, near Arequipa, Peru, where observations were conducted for two years under the direction of Professor W. H. Pickering. Professor Bailey then returned to Peru and took charge of the station. Later, he established a series of meteorological stations crossing the Andes at the respective elevations of 100, 4,150, 8,060, 13,300, 15,600, 19,200, 11,000 and 3,000 feet.

In coöperation with the BLUE HILL METEOROLOGICAL OBSERVATORY, under the direction of Mr. Rotch, meteorological observations are maintained, and the results published in the Annals of the Observatory. The Blue Hill Observatory is situated upon land recently taken by the State as a public park, but a portion of this land has been leased to Harvard College, in order to ensure the continuance of the meteorological observations.

The Observatory is now provided with a photographic telescope of greater size than that of any similar instrument hitherto constructed. This telescope is the gift of Miss C. W. BRUCE, of New York. Its object-glass consists of four lenses, each 24 inches in aperture. The work for which it is specially designed is the production of stellar charts, and photographs of stellar spectra. This instrument is now mounted at Arequipa, and is in use throughout every clear night, as are also numerous smaller instruments.

By the mutual consent of astronomers, the Kiel and Harvard Observatories have been selected as the centres for the prompt announcement of astronomical discoveries. For example, when a comet is discovered in America, its position is telegraphed to this Observatory, from here to Kiel, and thence to all the principal observatories of Europe.

Forty assistants are engaged in the work of the Observatory. The results obtained are published in a series of ANNALS, and now fill nearly fifty quarto volumes. The preparation of these volumes occupies a large part of the force at the Observatory in Cambridge. Besides this work, a large amount of observation is done there, several instruments being kept in constant use. The largest of these are the fifteen-inch and six-inch equatorial telescopes, the eight-inch transit circle, the eleven-inch Draper photographic telescope, the eight-inch photographic telescope, and the twelve-inch meridian photometer.

Instruction in Astronomy is not given at the Observatory, either by lectures or recitations. Facilities are freely offered to astronomers for making use of the library, buildings, grounds, instruments and photographs of the Observatory, so far as this can be done without interfering with regular work. Similar opportunities are sometimes offered to students specially devoting themselves to the study of Astronomy, but the constant employment of the principal instruments greatly limits the use that can be made of them for this purpose. Such students may apply for admission to the Director, with whom the fees for the privileges offered may be agreed upon. In some cases, a part or the whole of the fees may be remitted in consideration of services rendered in computation or other work.

THE STILLMAN INFIRMARY.

COMMITTEE IN CHARGE.

Henry Pickering Walcott, M.D.
Arthur Tracy Cabot, M.D.

Marshall Henry Bailey, M.D., *Medical Visitor.*

The Stillman Infirmary, the gift of Mr. James Stillman of New York, was erected in 1901 to serve as a hospital for students of Harvard University, and was first used during the academic year 1902–03. The building contains nine private rooms and two wards, each of the latter having space for ten beds. There are also ample quarters for the Matron, nurses, janitors, and servants, a large kitchen and laundry, serving room, servants' dining room, refrigerator room, store rooms, and a heating and ventilating plant. The building is of the most approved quality as to both its construction, which is fire-proof, and its appointments; and the accommodations for patients are the best that hospital experience has devised. The Infirmary is situated on Mt. Auburn Street, near the Cambridge Hospital, and commands the Charles River Parkway and Soldier's Field, a location which affords abundant air and sunshine, and permanent isolation from other buildings.

Any sick student of the University is admitted to the Infirmary by order of his physician or of the Medical Visitor; but the contagious diseases cannot be treated at the Infirmary until the completion of the Isolation Ward which has been provided by the generosity of Mr. Stillman. Such diseases will be, as heretofore, under supervision which will ensure necessary attendance by private physicians, or, in the case of needy students, by the Medical Visitor, whose services are gratuitous.

The regular charge for a bed in a ward, board, and ordinary nursing at the Infirmary is two dollars a day. It is expected that patients shall be attended by their own physicians; but needy students are attended by the Medical Visitor without extra charge.

The following endowment funds have been given toward the support of the Infirmary: —

The Robert Charles Billings Fund.
The Free Bed Fund of the Class of 1868.
The Free Bed Fund for the Stillman Infirmary.
The Herbert Schurz Memorial Free Bed Fund.
The Henry P. Walcott Fund.

EXERCISE AND ATHLETIC SPORTS.

THE HEMENWAY GYMNASIUM.

OFFICERS.

Dudley Allen Sargent, A.M., M.D., S.D., Director.
Frances Dohs, *Instructor in Gymnastics.*
Clarence Bertrand Van Wyck, *Recorder.*

This Gymnasium, named in honor of Augustus Hemenway, of Boston, of the Class of 1875, who gave it to the University, is a handsome and spacious structure, built in 1878 and equipped with the utmost thoroughness.

The growth of the University and the interest in this department during the past fifteen years has necessitated an increase of room and facilities, which Mr. Hemenway has met by making an extensive addition to the Gymnasium in 1895.

This new addition affords an increased floor area of 15,000 square feet, with locker, bathing, and dressing rooms, accommodating 2500 students.

An area of some 12,000 square feet of ground immediately connected with the Gymnasium has been enclosed, graded, and covered with asphalt, to afford facilities for practising gymnastic exercises and games in the open air.

The Gymnasium proper has a floor space of 30,000 square feet, including a large main hall for general exercise, a running-gallery, rowing-room, and basement for Bowling Alleys, Hand Ball Courts, and rooms for Fencing, Sparring, Wrestling, and other exercises.

The Main Hall is furnished with a large variety of light and heavy gymnastic apparatus and all the best patterns of the modern developing appliances.

The building is lighted throughout by electricity and warmed and ventilated by a novel arrangement of steam pipes, light wells, and air shafts.

The Gymnasium is open to all members of the University free of expense, on week days from 11 A.M. to 1 P.M., 3 to 5.30, and 8 to 10 P.M., except on Saturdays, when it is closed at 7 o'clock.

The attendance is voluntary, and the system adopted is one designed to meet the special wants of each individual. Realizing the great diversity in age, size, and strength, as well as in health, of the students who attend the University, the Director makes no attempt to group them into classes pursuing the same course of exercises.

Upon entering the University, each student is entitled to an examination by the Director, in which his physical proportions are measured, his strength tested, his heart and lungs examined, and information solicited concerning his general health and inherited tendencies. From the data thus procured, a special order of appropriate exercises is made out for each student, with specifications of the movements and apparatus which he may best use. These exercises are marked in outline on cards without charge, or in handbooks accompanied by charts at a small expense. After working on this prescription for three or six months, the student is entitled to another examination, by which the results of his work are ascertained, and the Director enabled to make a further prescription. Students holding Scholarships are expected to be examined twice a year; and those desiring to enter Athletic Contests are required to be examined by the Director and to obtain his permission so to do.

In addition to the individual prescriptions, there are classes in Free Movements and Light Gymnastics, designed to afford an opportunity for general development to all students of the University who are not members of the athletic teams or who are not in need of specially prescribed exercises.

All students of Harvard University desiring to enter as competitors in Athletic Contests are required to give evidence of their ability by making the following strength tests according to the Intercollegiate Agreement, in addition to the regular physical examinations: —

Candidates for the University Crew and Foot-ball Team and Weight Throwers are expected to make a total strength test of 800 points.

Candidates for the University Ball Nines and Track and Field Events, Class Crews and Foot-ball Teams and Gymnastic, Wrestling and Sparring Contests are expected to make a total strength test of 700 points.

Candidates for the University Lacrosse, Cricket, Tennis, and Golf Teams, Class Ball Nines, and Class Track and Field Events are expected to make a total strength test of 600 points.

These points are reckoned as follows: — The number of kilos. lifted with the back and legs straight, and the number of kilos. lifted with the legs bent, added to the strength of the grip of the right and left hand, expiratory power as tested by the manometer, and one-tenth of the weight in kilos. multiplied by the number of times that the person can raise his weight by dipping between the parallel bars and pulling his weight up to his chin on the horizontal bar. One twentieth of the lung capacity may be substituted for the lung strength or expiratory test. Where the strength test falls below the desired standard the capacity of lungs is taken into account in summing up the condition.

These tests are made and certificates granted on any day, excepting Saturday and Sunday, between 2 and 4 P.M., within two weeks previous to a contest, but no examinations are made or certificates granted on the day of the contest.

COMMITTEE ON THE REGULATION OF ATHLETIC SPORTS.

FACULTY MEMBERS.

HORATIO STEVENS WHITE, A.B., LL.D., *Professor of German*, CHAIRMAN.
ARCHIBALD CARY COOLIDGE, Ph.D., *Assistant Professor of History.*
ABRAM PIATT ANDREW, Jr., Ph.D., *Assistant Professor of Economics.*

GRADUATE MEMBERS.

THOMAS NELSON PERKINS, LL.B.
EDWARD HALL NICHOLS, M.D.
NORMAN WILLIAM BINGHAM, Jr., LL.B.

UNDERGRADUATE MEMBERS.

JAMES ATWOOD BURGESS, *Class of 1904.*
RALPH SANGER, *Class of 1904.*
JOHN PERRY BOWDITCH, *Class of 1905.*

ROGER ERNST, A.B., GRADUATE TREASURER.

The President and Fellows established the Committee on the Regulation of Athletic Sports by the following vote, to which the Overseers consented: —

"*Voted*, That the following be adopted as one of the standing rules and orders of the President and Fellows and the Board of Overseers: —

"A Committee for the Regulation of Athletic Sports shall hereafter be annually appointed and chosen as follows: three members of the University Faculties, and three graduates of the College — these six to be appointed by the Corporation with the consent of the Overseers; and also three undergraduates to be chosen for each College year, during the first week in June of the preceding College year, by the majority vote of the following students: the Presidents of the Senior, Junior, Sophomore, and Freshman classes, and a representative from each of the following Athletic organizations, the Boat Club, the Cricket Club, and the Athletic, Base-ball, Foot-ball, Lacrosse, and Tennis Associations, who shall be called together for the purpose of making this choice by the President of the University.

"This Committee shall have entire supervision and control of all athletic exercises within and without the precincts of the University, subject to the authority of the Faculty of Arts and Sciences, as defined by the Statutes."

Under the authority thus conferred the Committee exercises a general supervision over the grounds and buildings devoted by the University to athletic sports and exercise; over the times and places of athletic contests; and over the physical condition of those engaged in them. The regulations framed by the Committee forbid the employment of unauthorized persons as trainers, and require intercollegiate and other contests to be held at such times and places as will cause least interference with study. No person is permitted to take part in athletic contests without a physical examination by the Director of the Gymnasium, and his permission so to do. No person who is not a student of some department of the University in full and regular standing is allowed to take part in any athletic contest or exhibition. The Committee chooses its own officers, and appoints a Graduate Treasurer, who exercises supervision over the accounts of all athletic organizations using University grounds or buildings. The Committee makes a report annually to the President of the University.

GROUNDS AND BUILDINGS FOR ATHLETIC USES.

Besides the Gymnasium, other buildings are held, either by the University or by trustees, for the exclusive use of students of the University.

A substantial building for the use of the Base-ball and other teams was erected in 1897–98 to the memory of Mr. HENRY ASTOR CAREY, in exchange for the building on Holmes Field surrendered to the University for purposes of instruction. It has a floor space of 7700 square feet.

The new UNIVERSITY BOAT HOUSE, the gift of the Harvard Club of New York City, was built in 1900 for the general use of the students. It is situated on Charles River, about half a mile from the College, and is at present occupied by regular crews and by the Newell Boat Club. It has locker and boat room for about 500 students. A number of rowing machines and a well equipped rowing tank have been placed in the building, for winter work.

By the gift of Mr. George Walker Weld, of the Class of 1860, a second boat house was erected in 1889–90 for the use chiefly of students not rowing on regular crews. It is situated about one third of a mile from the College, and has lockers and boat-storage sufficient for the use of 300 students.

By subscriptions from Alumni the "Locker Building" was erected in 1893–94 on Soldier's Field. This building has a capacity of 1500 lockers, and contains also large shower-rooms and dressing-rooms.

A Gate Lodge was erected near the entrance to Soldier's Field during the fall of 1899. It contains one large room for the general use of students and their friends, and several smaller rooms for the use of the attendant in charge of the athletic grounds.

For out-door exercise, two grounds have been provided.

Jarvis Field, a few hundred feet from Holmes Field, is about four acres in area, and is used exclusively by tennis-players.

By a gift made to the University in 1890 by Mr. Henry Lee Higginson, of the Class of 1855, the students are provided with an additional play-ground of twenty acres. This new field, named by the donor the Soldier's Field, is situated in Allston, at a short distance across the Charles River, and is within easy reach of the College Yard. It is used for foot-ball, base-ball, and other sports. Upon this field seats for about fifteen thousand persons have been erected; and during the current year, by a gift from the Class of 1879, a stadium will be completed with accommodations for upwards of twenty thousand spectators. Since 1898, the Longfellow Marsh has been enclosed to form part of Soldier's Field, and by improvement of the marsh one or two acres have been added to the play-ground every year. The total available area will ultimately be more than sixty acres.

SCHOOLS, COLLEGES, AND UNIVERSITIES FROM WHICH STUDENTS HAVE ENTERED THE LAWRENCE SCIENTIFIC SCHOOL 1894–1903 INCLUSIVE.

Abington (Mass.) High School.
Adams Academy, Quincy, Mass.
Afton Normal College, Afton, Iowa.
Albany (N.Y.) State Normal College.
Albion College, Albion, Mich.
Alfred University, Alfred, N.Y.
Allen Brothers' Private School, Newton, Mass.
Amherst College, Amherst, Mass.
Anglo-American College, Paris, France.
Ansonia (Conn.) High School.
Arkansas Industrial University, Fayetteville, Ark.
Arlington (Mass.) High School.
Armour Institute of Technology, Chicago, Ill.
Arms Academy, Shelburne Falls, Mass.
Asheville School, Asheville, N. C.
Auburn (N.Y.) High School.
Augustana College, Rock Island, Ill.
Ayer (Mass.) High School.

Ballou & Hobigand's School, Boston, Mass.
Baltimore (Md.) City College.
Barcelona University, Spain.
Barton Academy, Mobile, Ala.
Bath (Me.) High School.
Bedford (England) Grammar School.
Belmont (Cal.) School.
Belmont (Mass.) School.
Belmont (Mass.) High School.
Berkeley High School, New London, Conn.
Berkeley School, Boston, Mass.
Berkeley School, Washington, D.C.
Bethany College, Bethany, W. Va.
Blake's, W. S., Private School, New York, N.Y.
Blight School, Philadelphia, Pa.
Boston (Mass.) College.

Boston (Mass.) English High School.
Boston (Mass.) Evening High School.
Boston (Mass.) Free Atelier.
Boston (Mass.) Latin School.
Boston (Mass.) University.
Boys' High School, Brooklyn, N.Y.
Bradford (Pa.) High School.
Bridgeport (Conn.) High School.
Bridgewater (Mass.) High School.
Brighton (Mass.) High School.
Brigham Young College, Logan, Utah.
Bristol Academy, Taunton, Mass.
Brockton (Mass.) High School.
Bromfield School, Harvard, Mass.
Bromfield-Pearson School, Tufts College, Mass.
Brookline (Mass.) Grammar School.
Brookline (Mass.) High School.
Brooklyn (N.Y.) Evening Schools.
Brooklyn (N.Y.) High School.
Brooklyn (N.Y.) Latin School.
Brooklyn (N.Y.) Polytechnic School.
Brown College Prep. School, Philadelphia, Pa.
Brown University, Providence, R. I.
Browne & Nichols's School, Cambridge, Mass.
Browning's, J. A., Private School, New York, N.Y.
Bucknell University, Lewisburg, Pa.
Buchtel College, Akron, O.
Buffalo (N.Y.) High School.
Bulkeley School, New London, Conn.
Bussey Institution, Jamaica Plain, Mass.

California School of Mechanic Arts, San Francisco, Cal.
Cambridge (Mass.) English High School.
Cambridge (Mass.) Latin School.
Cambridge (Mass.) Manual Training School.
Carrollton Preparatory School, Charlestown, Mass.
Case School of Applied Science, Cleveland, O.
Cedarcroft, Cornwall, N.Y.
Centre College, Danville, Ky.
Central High School, Washington, D. C.
Charlestown (Mass.) High School.
Chauncy Hall School, Boston, Mass.
Chelsea (Mass.) High School.

Chelsea (Mass.) Grammar School.
Chem. Bact. Institute, Berlin, Germany.
Chenault's, D. A., School, Louisville, Ky.
Chicago (Ill.) Latin School.
Chicago (Ill.) Manual Training School.
Clarkson School of Technology, Potsdam, N.Y.
Cleveland (Ohio) Central High School.
Cloyne School, Newport, R. I.
Coaching School, New York, N.Y.
Coburn Classical Institute, Waterville, Me.
Cohasset (Mass.) High School.
Colby Academy, New London, N. H.
Colby University, Waterville, Me.
Colgate University, Hamilton, N.Y.
College of Agriculture, Wageninge, Holland.
College of the City of New York, N.Y.
Collegio Pará e Amazonas, Para, Brazil.
Colorado College, Colorado Springs, Col.
Colorado High School, Colorado Springs, Col.
Colorado School of Mines, Golden, Col.
Columbia High School, So. Orange, N. J.
Columbia Institute, New York, N.Y.
Columbia University, New York, N.Y.
Columbian University, Washington, D.C.
Concord (Mass.) High School.
Concord (Mass.) Home School.
Concord (Mass.) School.
Concord (N. H.) High School.
Condon School, New York, N.Y
Conn. Literary Institute, Duffield, Conn.
Cooper Union Night School, New York, N.Y.
Cornell University, Ithaca, N.Y.
Cutler's, A. H., Private School, New York, N.Y.
Cutler's, E. H., School, Newton, Mass.

Dalhousie College, Halifax, N.S.
Dartmouth College, Hanover, N.H.
David Prouty High School, Spencer, Mass.
Dean Academy, Franklin, Mass.
Dedham (Mass.) High School.
Deering (Me.) High School.
DeLancey School, Philadelphia, Pa.
De La Salle School, Chicago, Ill.

Delaware Literary Institute, Franklin, N.Y.
Demerritte School, Boston, Mass.
Denison (Texas) High School.
Denison University, Granville, Ohio.
DePauw University, Greencastle, Ind.
Detroit (Mich.) College of Law
Detroit (Mich.) High School.
De Veaux School, Niagara Falls, N.Y.
Dickinson (Mass.) High School.
Dorchester (Mass.) High School.
Drisler School, New York, N.Y.
Dubuque (Ia.) High School.
Duluth (Minn.) Central High School.
Dummer Academy, So. Byfield, Mass.
Durfee, B. M. C., High School, Fall River, Mass.

East Division High School, Milwaukee, Wis.
Eayr's, W. N., Private School, Boston, Mass.
Ecole des Beaux Arts, Paris, France.
Eliot Grammar School, Boston, Mass.
Elmwood School, Buffalo, N.Y.
Emory College, Oxford, Ga.
Englewood (N. J.) School for Boys.
Erasmus Hall High School, Brooklyn, N.Y.
Evening Institute, Y. M. C. A., Boston, Mass.
Everett (Mass.) High School.

Fiske University, Nashville, Tenn.
Fitchburg (Mass.) High School.
Flexner's, Abraham, School, Louisville, Ky.
Florence (S.C.) Public Schools.
Florida Agricultural College, Lake City, Fla.
Flushing (N.Y.) High School.
Fordham (N.Y.) College.
Foxcroft (Me.) Academy.
Framingham (Mass.) High School.
Franklin (Ind.) College.
Franklin School, Cincinnati, Ohio.
Friends' Academy, New Bedford, Mass.
Frye's, C. B., School, Boston, Mass.

Gardiner (Me.) High School.
Gardner (Mass.) High School.
Georgetown University Preparatory Dept., Washington, D.C.

Gloucester (Mass.) High School.
Grand Island (Neb.) High School.
Groton School, Groton, Mass.
Gunnery School, Washington, Conn.

Hackley Hall School, Tarrytown, N.Y.
Hale's, Albert, Private School, Boston, Mass.
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Harrison College, Barbados, W. I.
Harrow School, England.
Harvard College, Cambridge, Mass.
Harvard Graduate School, Cambridge, Mass.
Harvard Medical School, Boston, Mass.
Harvard School, Chicago, Ill.
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Haverhill (Mass.) High School.
Haverhill (Mass.) Public School.
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Hedding College, Mingdon, Ill.
Highgate School, England.
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Hildreth's, Arthur, School, Boston, Mass.
Hilhouse High School, New Haven, Conn.
Hill School, Pottstown, Pa.
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Holderness School, Plymouth, N. H.
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Horace Mann School, New York, N.Y.
Hotchkiss School, Lakeville, Conn.
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Hudson River Military Academy, Nyack-on-Hudson, N.Y.
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Illinois State Normal University, Normal, Ill.
Indiana University, Bloomington, Ind.
Indianapolis (Ind.) Academy.
Indianapolis (Ind.) High School.
Iowa College, Grinnell, Ia.
Ipswich (Mass.) High School.
Ironton School, Ironton, Penn.

Jenner's, Wm., Private School, Syracuse, N.Y.

Kansas University, Topeka, Kans.
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Kendall's, Joshua, Private School, Cambridge, Mass.
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Kenwood School, Chicago, Ill.
King's College, London, England.
King's School, Stamford, Conn.
Kingston School of Mines, Kingston, Ontario, Canada.
Knox College, Galesburg, Ill.

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Lynn (Mass.) Classical High School.
Lynn (Mass.) High School.

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McMaster University, Toronto, Canada.
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Norwich University, Northfield, Vt.

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Peekskill (N.Y.) Military Academy.
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Philadelphia (Pa.) College of Pharmacy.
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Woodbridge School, New York, N.Y.
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The Academic Year begins on the Thursday following the last Wednesday in September.

Commencement Day is on the last Wednesday in June.

The Vacation begins on the day after Commencement Day, and ends on the last Wednesday in September.

There are two short recesses, at Christmas and in April.

For copies of this Catalogue, and for further information, address
J. L. LOVE, Secretary, Lawrence Scientific School,
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☞ All official letters and all applications addressed to the Administrative Board of the School, or to the Dean, should be sent to the Secretary's Office, 16 University Hall.

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